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WM. A. TAYLOR, Chief

Washington, D. C.

PROFESSIONAL PAPER

July 25, 1918

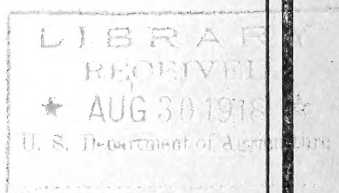
**CITRUS-FRUIT IMPROVEMENT
A STUDY OF BUD VARIATION IN THE
VALENCIA ORANGE**

By

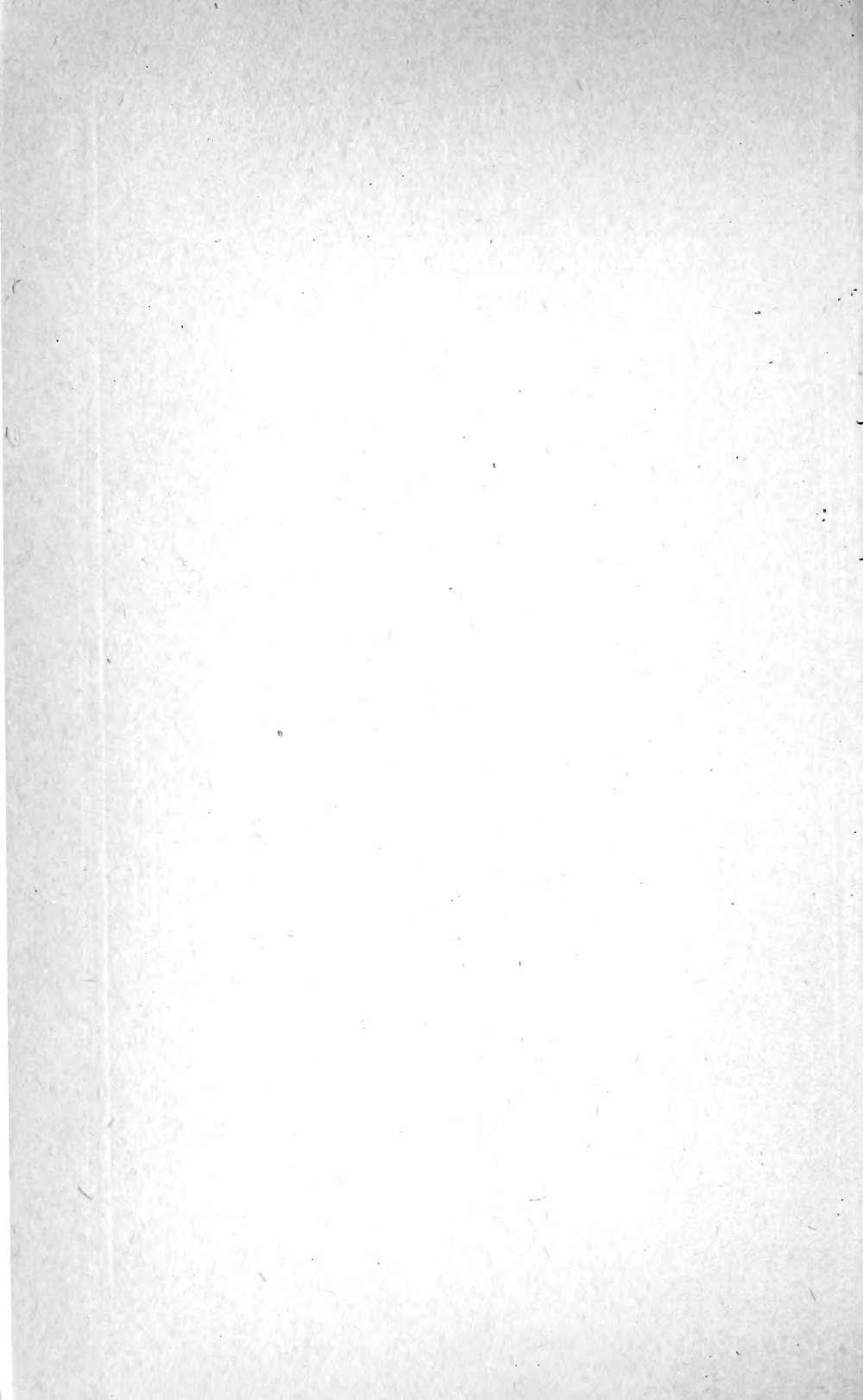
A. D. SHAMEL, Physiologist in Charge, L. B. SCOTT, Pomologist, and C. S.
POMEROY, Assistant Pomologist, Fruit-Improvement Investigations
Office of Horticultural and Pomological Investigations

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CITRUS-FRUIT IMPROVEMENT: A STUDY OF BUD VARIATION IN THE VALENCIA ORANGE.¹

By A. D. SHAMEL, *Physiologist in Charge*, L. B. SCOTT, *Pomologist*, and C. S. POMEROY, *Assistant Pomologist, Fruit-Improvement Investigations, Office of Horticultural and Pomological Investigations.*

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CALIFORNIA CITRUS VARIETIES.

The commercially important varieties of citrus fruits grown in California are the Washington Navel, the Valencia, and the Mediterranean (*Mediterranean Sweet*) oranges; the Dancy tangerine; the Eureka and Lisbon lemons; and the Marsh (*Marsh Seedless*) grapefruit. Other less important varieties grown only to a limited extent include the St. Michael, Navelencia, Ruby blood, and Malta blood oranges, and the Villafranca lemon. Of the two leading orange varieties the Washington Navel is by far the most widely cultivated, producing an annual crop of about 27,000 carloads of fruit.² This variety ripens its fruit from November to June, inclusive. The Valencia ripens its fruit from June to October, inclusive, and produces

¹ This is the second in a series of publications summarizing the citrus-fruit improvement investigations of the Department of Agriculture. The first report of this character was presented in the following publication: Shamel, A. D., Scott, L. B., and Pomeroy, C. S. Citrus-fruit improvement: A study of bud variation in the Washington Navel orange. U. S. Dept. Agr. Bul. 623, 146 p., 16 figs., 19 pl. 1918. In that bulletin the methods of conducting the investigational work are described more in detail than in the present publication.

² Wallschlaeger, F. O. The world's production and commerce in citrus fruits and their by-products. Citrus Prot. League, Cal., Bul. 11, p. 70. 1914.

an annual crop of about 8,500 carloads. All other varieties of oranges grown in California produce annually about 4,500 carloads of fruit, ripening their crops mostly in the spring and early summer months. At the present time the increase in the plantings of the Valencia orange in California is greater than that of any other orange variety. For this reason studies of the characteristics of the variety and methods of improving and increasing its production through bud selection during propagation are of special interest.

HISTORY OF THE VALENCIA VARIETY.

The Valencia orange (*Citrus aurantium sinensis* L.) was introduced into California from at least three sources at about the same time. According to William Wood,¹ horticultural commissioner of Los Angeles County, A. B. Chapman and George H. Smith, of that county, received an unlabeled package of orange trees from Thomas Rivers, of London, England, in 1876. Mr. Chapman planted these trees in the nursery on his ranch at San Gabriel, Cal. Buds were propagated from all of these trees and grown until they came into bearing. The only variety which proved to be of value was one which Mr. Chapman called Rivers Late. Col. J. H. Dobbins, of San Gabriel, secured buds of this variety, and when the trees propagated from these buds came into bearing a shipment of the fruit was sent to eastern markets. These oranges brought \$4 per box. As a result of this experience the variety became very popular and was widely planted by citrus growers. At that time a citrus grower from Valencia, Spain, was shown the fruit and identified it as the variety called in Spain "La Naranga Tarde de Valencia." Mr. Chapman adopted this name, and it has since been called the Valencia Late, or, more commonly, the Valencia orange.

The other sources of trees of this variety were introductions into California from Florida by several southern California nurserymen, particularly Frost and Burgess² and Twogood and Cutter, located at Riverside. The variety had been introduced into Florida by two different persons. About 1870 General Sanford, of Palatka, Fla., obtained a variety of orange from the Rivers nurseries. This variety was labeled Brown.³ Shortly after the Sanford introduction Mr. E. H. Hart, of Federal Point, Fla., introduced the variety into Florida from the Parsons nursery of Flushing, N. Y.⁴ The Parsons nurseries had received the trees from the Rivers nurseries. In shipping the trees to Florida the label was lost. When these trees fruited Mr. Hart exhibited samples of the fruit at a meeting of the Florida State

¹ Letter from Mr. William Wood, Los Angeles, Cal., Jan. 5, 1916.

² Letter from Mr. George Frost, Riverside, Cal., Jan. 20, 1916.

³ Statement received from Mr. Daniel Houston, Zellwood, Fla., May 9, 1916. Mr. Houston was formerly manager of General Sanford's properties.

⁴ Letter of Mr. E. H. Hart to Prof. E. H. Van Deman, U. S. Department of Agriculture, Apr. 25, 1888.

Horticultural Society and the nomenclature committee of that society gave them the name Hart's Tardiff, which was successively changed to Hart's Tardy and Hart's Late. The American Pomological Society has adopted the name Hart for this variety, but the names mentioned above are still in common use by nurserymen and growers in Florida. On comparison, the fruits of the Hart introduction were found to be identical with those grown by General Sanford under the name Brown.¹ Budded trees of both the Sanford and Hart introductions were included in the earlier shipments of trees from Florida to California.² It was soon found, however, that the Brown, Hart, and Valencia were the same variety, and as it seemed probable that the California Valencia Late and the Florida introductions were nearly related and came from the same original source, the name Valencia is used in California to designate all trees which have descended from these different introductions. Orchards grown from trees or buds received from these sources show only minor differences, if any, and when present these are of such a character as may be due to local soil and climatic conditions rather than to inherent varietal differences. As a rule, the Chapman introduction of Valencia orange has a more globular shape than the Florida strains and is said to ripen somewhat earlier. The Chapman trees usually are more upright in habit of growth than those of the Florida Valencia, but not enough reliable information is available regarding this or other comparative varietal tree and fruit characters of these introductions for any final conclusions as to inherent differences between them.

The performance records of individual trees and the observations, illustrations, and notes of trees and fruits contained in this bulletin have all been obtained from trees which trace back to the Florida introductions now commonly known in California as the Valencia orange. These records and observations have been made in the orchards of southern California and for the most part in those located in Riverside County.

VARIABILITY WITHIN THE VARIETY.

Previous to this study it had been generally supposed that one Valencia tree was as good as another and that for a series of years they would produce practically equivalent crops. Contrary to this, these investigations have proved that instead of the Valencia variety being stable and constant, it is composed of several distinct strains which differ from each other in many characters of fruit and tree. The term "strain" is used here to designate a group of individuals of a horticultural variety which differ from all other indi-

¹ Letter of Mr. E. H. Hart to Prof. E. H. Van Deman, U. S. Department of Agriculture, June 10, 1887.

² Statement received from Mr. Daniel Houston, Zellwood, Fla., May 9, 1916.

viduals of the variety in one or more constant and recognizable characteristics and which are capable of perpetuation through vegetative propagation. Within the various strains there are variations in the amount and commercial quality of the fruits produced by the individual trees. The variability of individual-tree production in the orchard as regards quantity, commercial quality, time of ripening, and other characteristics is of the highest importance to growers of fruit varieties.

The variability of the trees and fruits within the variety is of fundamental significance from the standpoint of the grower and in any study of the conservation and stabilization of the variety as a whole.

The Valencia strains are distinguished by differences in habits of growth, time of ripening fruits, quantity and quality of crops, and other definite and marked characteristics. The trees of certain strains were found to have upright habits of growth, while those of other strains are drooping or spreading. The trees of some of the strains produce, as a rule, full crops of the best-grade fruit, while those of other strains produce light crops of low-grade fruit. The trees of at least one of the strains produce early-ripening crops, while those of other strains produce later ripening fruits. The leaves of the trees of some of the strains are large, broad, and bluntly rounded in shape, while trees of other strains have small, narrow, and sharply pointed leaves.

In many cases, fruits of two or more of the different strains have been found on the same tree grown from a single bud and therefore upon the same individual stock. Such instances have shown the fallacy of the theory that the different strains are variations due to climatic or soil conditions or the influence of different stock. Later, it was found that the different strains occurring in a single tree could be isolated through bud selection in propagation, thus proving that the differences observed were true inherent cases of bud variation.

The mixture of strains in the Valencia orchards under observation was found to be so marked and frequent as to warrant careful investigations of their relative value. The results of these investigations, which have covered more than four years, together with suggestions for the isolation of the best strains of this variety through bud selection and for the stabilization of the variety through the propagation of only the most desirable strains, are set forth in the following pages.

OCCURRENCE AND FREQUENCY OF BUD VARIATIONS.

A casual observation of the Valencia orange trees selected for these investigations will reveal little of the startling condition of bud variability existing in the trees and their fruits. Several Valencia orange growers, with many years of experience in the culture of this

variety, have expressed genuine surprise when some of the bud variations of foliage and fruits occurring on their trees have been pointed out to them. As a matter of fact, while bud variations have been known to exist in trees of this variety for some time, their frequency and importance have not been fully realized until very recently and as a result of these investigations.

Twelve important strains of the Valencia variety have been found and described during these investigations. Several other minor and less frequent variations have been found from time to time, but, so far as is now known, they are of little significance or importance in commercial orchard practice or in the present studies.

The total number of strains existing in the Valencia variety is not known. Additions are continually being made to the list, as knowledge of the variety grows and the extent of the investigations widens to include observations of a larger number of trees.

The extent of the occurrence of diverse strains of the Valencia variety in established bearing orchards has been found to be even greater than the occurrence of similar variations in Washington Navel groves. The percentage of off-type trees, i. e., marked variations from the best or Valencia strain, found in individual commercial orchards is practically the same as was found in Washington Navel orange orchards (from about 10 to approximately 75 per cent),¹ but a larger proportion of the Valencia orchards have shown the higher percentages of trees of variable strains.

The name Valencia has been applied to the best strain of the variety, because, as nearly as can be determined, it is similar in type of tree and of fruit to the original Valencia introductions into California which were propagated on account of their superior quality and productiveness. This strain bears the heaviest crops and the most desirable fruits of any of the strains of this variety under observation. It is the strain upon which the reputation of the variety has been founded and which under present conditions is the most desirable for cultivation in California.

As a rule, the younger Valencia orchards show a larger proportion of trees bearing inferior fruits than the older orchards. This condition indicates that the prevailing methods used in propagating this variety have resulted in the perpetuation of an increasingly large proportion of trees of undesirable strains.

OBJECTS OF THE INVESTIGATIONS.

The objects of the investigations reported in this bulletin are (1) to ascertain the variations which have taken place in the Valencia orange through bud variation and to learn the comparative value of

¹ Shamel, A. D., Scott, L. B., and Pomeroy, C. S. Citrus-fruit improvement: A study of bud variation in the Washington Navel orange. U. S. Dept. Agr. Bul. 623, 146 p., 16 fig., 19 pl. 1918.

the different strains for commercial fruit production; (2) to determine the extent to which undesirable variations have been propagated, as shown by the percentage of such inferior trees in the present bearing groves; and (3) through improved methods of propagation to control the extent to which undesirable variations in the future shall enter into the population of commercial Valencia orange groves. Briefly stated, these investigations have been undertaken for the purpose of discovering practical methods for conserving and stabilizing the Valencia orange variety.

PLAN OF THE INVESTIGATIONS.

The investigations have been carried on by means of individual-tree performance records and observations.

The term "performance record" is here used to designate the record of the quantity and the commercial quality of the fruits borne by an individual tree during one or more years.

The term "performance-record plat" as used in these investigations means a group of trees grown under comparable conditions and selected for the purpose of determining the relative behavior of the trees by means of individual-tree records of production, observations, and descriptive notes.

The primary conditions considered in the location of the performance-record plats of Valencia oranges in which the investigational work was conducted were (1) full-bearing trees planted on virgin land, so as to eliminate all possible influence of previous soil or cultural conditions; (2) uniform soil where little or no fertilizers of any kind had been applied and where uniform cultural treatments had been practiced from year to year; (3) the absence of any radical pruning or other tree treatment; (4) the absence or effective control of insect enemies and diseases; (5) trees in a normal, healthy condition, showing satisfactory vegetative growth; (6) a knowledge of the character of the stocks and the sources of the buds used in propagation; (7) sufficient elevation to assure natural protection from frost and other unfavorable conditions; and (8) the prospect of the control of the orchard by the same owners for a series of years.

These conditions, particularly those of soil and culture, are not conducive to large yields, but are favorable to the study of inherent individual-tree variability and behavior. As the object of these investigations is not the measurement of the highest possible yield or the study of the influence of cultural conditions on the production of large crops, but rather the behavior of trees under conditions as nearly natural as it is possible to secure in commercial citrus orchards in California, it was deemed wise in this selection to eliminate so far as practicable all local environmental influences and abnormal conditions.

The principal plats of Valencia oranges finally selected for individual-tree performance-record work are located in a citrus orchard of approximately 750 acres about equally divided between Valencia oranges, Washington Navel oranges, and Eureka lemons. A study of all the Valencia trees on this ranch was made before the plats of trees for detailed observation were finally selected. This selection was made with the idea of securing a representative lot of trees which would include typical trees of some of the most important strains of the variety. Trees to the number of 115 which had been planted in the fall of 1903 were selected. Actual performance-record work was begun in 1912. Complete annual records secured from 105 of these trees for four successive years are available for study. Later in 1912 a plat of 9 trees of the Valencia strain was selected in another Valencia orchard several miles distant, where soil conditions are markedly different. In 1914 an additional plat of 55 trees was chosen in the same orchard where the first plat was located, mainly for the purpose of studying the individual-tree behavior of the Valencia or best strain of the Valencia variety. In this publication the discussion of results will be confined to those secured from the records obtained from the plat first selected.

METHODS OF KEEPING PERFORMANCE RECORDS.

In securing the individual-tree performance records for investigational purposes¹ each tree is given a number, and the trees in the plats are marked annually with cloth streamers to prevent their being picked accidentally by the regular picking crew of the ranch. Each tree is picked separately, and all notes concerning the quantity and quality of fruit borne by that tree are recorded before the picking of the next tree is begun.

The fruits are assorted into three grades: (1) An Orchard grade, including all of the valuable first-class commercial fruits; (2) a Standard grade, including marked, misshapen, unevenly colored, or other blemished fruits which are distinctly of a second class in commercial quality, but still worthy of marketing; and (3) a Cull grade, consisting of fruits of such inferior quality as to be wholly unfit for the market. By means of a small mechanical sizer, similar to those in actual use in orange-packing houses, the fruits in the Orchard and Standard grades are sized into the commercial sizes varying from 288 to 80. The fruits of each size in each grade are counted and weighed and the notes recorded on forms arranged especially for this

¹ For a complete description of the methods followed in securing the investigational performance records see the following publication: Shamel, A. D., Scott, L. B., and Pomeroy, C. S. Citrus-fruit improvement: A study of bud variation in the Washington Navel orange. U. S. Dept. Agr. Bul. 623, 146 p., 16 fig., 19 pl. 1918.

Directions for securing performance records as a part of commercial orchard picking operations are presented in the following publication: Shamel, A. D. Citrus-fruit improvement: How to secure and use tree-performance records. U. S. Dept. Agr., Farmers' Bul. 794, 16 p., 4 fig. 1917.

purpose.¹ The culls are not sized, but their number and weight are recorded.

The field notes are transferred to annual record sheets, illustrations of their use being shown in the upper part of section A of Table III, and these notes in turn are transferred to period record sheets, illustrations of the use of which are shown in other parts of the same table. Thus the record of each tree is assembled in one place for comparative study.

DESCRIPTIONS OF SOME OF THE IMPORTANT STRAINS.

In addition to the performance records, as opportunity permits descriptive notes are secured of typical trees and fruits of the different strains. Inasmuch as the greatest commercial importance lies in the character of the fruits, the main emphasis in these records is placed upon the characteristics of the fruits of the important strains and their relative commercial value.

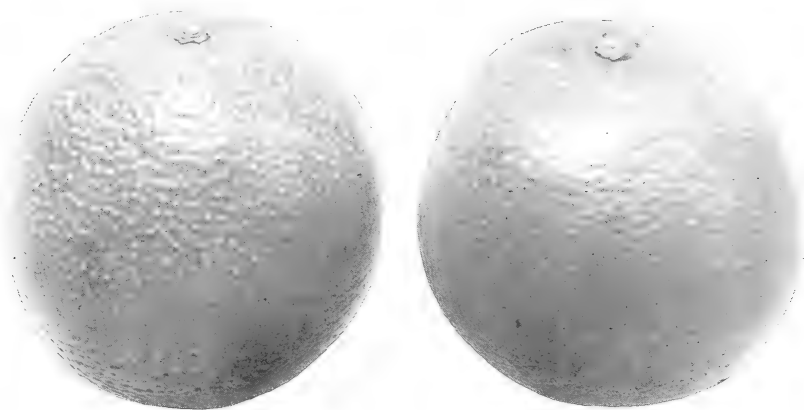
Brief descriptions of some of the important Valencia strains arising from bud variations which have been found in the investigational performance-record plats are here given.

VALENCIA STRAIN.

The trees of the Valencia strain vary considerably in regularity of production and as a whole may be divided into three general classes: (1) Regular producers, (2) alternate-season producers, and (3) irregular producers, bearing full crops only at infrequent intervals. This condition indicates that the Valencia strain as here considered is probably made up of several minor strains, which upon further investigation may be classed among the major strains. The trees, as a rule, have an erect and spreading habit of growth, developing open heads with large rounded leaves.

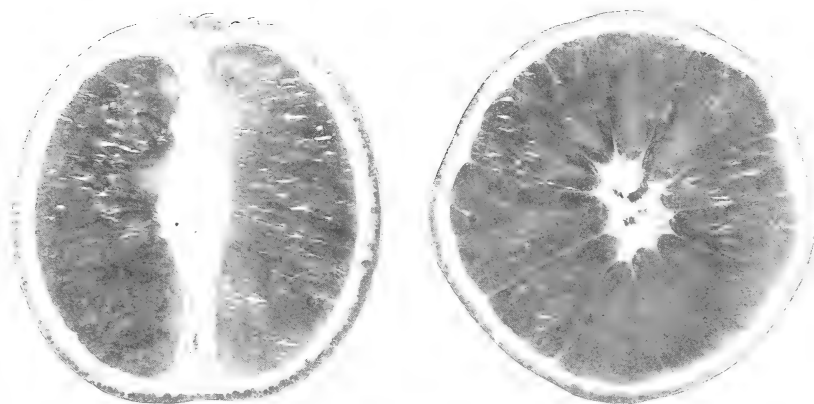
The typical fruits of this strain, illustrations of which are shown in Plate I, are globular, with a tendency to flattened blossom ends; size medium; texture of skin smooth; color bright orange; rind thin; rag tender; juice abundant and sweet; seeds from none to 10, averaging in these observations about 3 per fruit. The fully ripened fruits have a good quality, inferior only to that of the Washington Navel orange among California citrus fruits. Under certain climatic conditions the ripe fruits on the trees are likely to start a new growth, resulting in the fruits turning green in color. This second development of green color is likely to disappear after picking, and its loss can be hastened by increasing the temperature and humidity conditions of the stored fruits.

¹ Shamel, A. D. Citrus-fruit improvement: How to secure and use tree-performance records. U. S. Dept. Agr., Farmers' Bul. 794, tab. 1, pp. 10-11. 1917.



P13639HP

FIG. 1.—SIDE VIEWS SHOWING THE CHARACTERISTIC TEXTURE OF THE RIND.



P13640HP

FIG. 2.—AXIAL AND CROSS SECTIONS OF THE SAME FRUITS.

TYPICAL FRUITS OF THE VALENCIA STRAIN OF THE VALENCIA ORANGE.

(About three-fourths natural size.)



P240A-HP AND P241A-HP

TYPICAL FRUITS OF THE CORRUGATED STRAIN OF THE VALENCIA ORANGE. TWO VIEWS ARE SHOWN OF THREE FRUITS.

(About two-thirds natural size.)

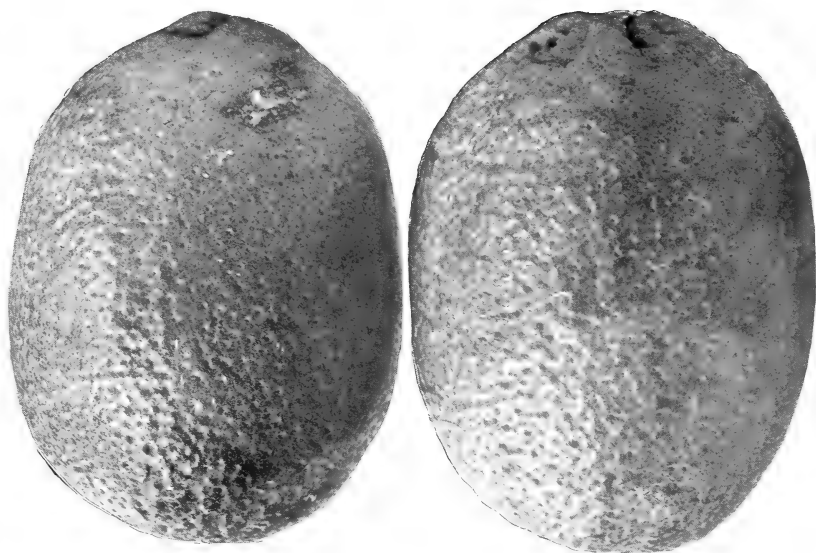


FIG. 1.—SIDE VIEW OF THE FRUITS, SHOWING THEIR CHARACTERISTIC CYLINDRICAL SHAPE.

P9137HP



FIG. 2.—CROSS AND AXIAL SECTIONS OF THE SAME FRUITS.
TYPICAL FRUITS OF THE LONG STRAIN OF THE VALENCIA ORANGE.

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(About four-fifths natural size.)



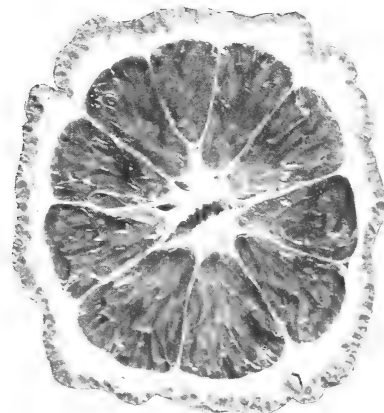
P9122HP

FIG. 1.—SIDE VIEW, SHOWING THE SHAPE OF THE FRUIT AND ITS CHARACTERISTIC RIBBED SURFACE.



P9121HP

FIG. 2.—ENDS OF THE SAME FRUITS.



P9123HP

FIG. 3.—CROSS SECTIONS OF THE SAME FRUITS.

TYPICAL FRUITS OF THE RIBBED STRAIN OF THE VALENCIA ORANGE.

(About nine-tenths natural size.)

CORRUGATED STRAIN.

The trees of the Corrugated strain are not so productive, as a rule, as those of the Valencia strain. They have a drooping habit of growth, and the leaves are usually smaller than those of the Valencia strain and are sharply pointed.

The typical fruits, as shown in Plate II, are oblong or cylindrical; size usually large; texture of skin very rough, corrugated; rind thick; color greenish; rag tough; juice scant, of poor quality and flavor; seeds averaging 2 or 3 per fruit; in fact, these fruits are not worth shipping to eastern markets, but in these investigations they have been included in the standard grade for this variety. This strain, however, is one of the most interesting in the variety for purposes of studying the behavior of bud mutations in citrus fruits.

LONG STRAIN.

The habit of growth and foliage characteristics of the Long strain are similar to those of the Valencia strain, but the trees are less productive.

The fruits, as shown in Plate III, are cylindrical and much longer than those of other strains; size, as measured by cross diameter, small to medium; texture smooth; color bright orange; rag tender; juice abundant, sweet, of good quality; seeds averaging 1 or 2 per fruit. The peculiar shape of these fruits makes them unsuitable for packing and marketing under prevailing conditions. This strain frequently occurs as limb sports in trees of the Valencia strain.

RIBBED STRAIN.

The trees of the Ribbed strain are usually very irregular in production, bearing full crops some seasons, followed by several seasons of very light production. The habit of growth is usually drooping, and the foliage is sparse, the leaves being small and sharply pointed.

The typical fruits, as shown in Plate IV, are globular, sometimes somewhat flattened on both stem and blossom ends; size small; texture coarse; color pale yellow; rind thin to medium; rag tender; juice abundant, inferior in quality and flavor to that of the fruits of the Valencia strain; seeds averaging 2 per fruit. The ribbed character of the rind gives the fruits a striking appearance, but it detracts from their commercial value under prevailing market conditions.

YELLOW STRAIN.

The productiveness of the trees of the Yellow strain is about the same as those of the Ribbed strain, except that they show a tendency to more regularity of annual production. The habit of growth is spreading and drooping. The foliage is of medium density, the leaves being medium in size and sharply pointed.

The typical fruits, as shown in Plate V, are globular; size small; texture very smooth; color deep yellow; rind very thin; rag very tender; juice abundant, very sweet; seeds averaging 1 per fruit. Frequently the skins of these fruits have small spots or streaks of red, as is the case with the fruits of the Yellow strain of the Washington Navel orange. On account of the small size and yellow color of the fruits, they are inferior to fruits of the Valencia strain for commercial purposes under prevailing conditions. These fruits usually ripen about one month earlier than those of the Valencia strain, and for this reason may prove to be of value for some climatic and soil conditions. They are very frequently found as limb sports in trees of the Valencia or other strains.

SMOOTH STRAIN.

The trees of the Smooth strain are much less productive than those of the Valencia strain, and have an upright, spreading habit of growth. The foliage and other tree characteristics are similar to those of trees of the Valencia strain.

The fruits, illustrations of which are shown in Plate VI, are usually somewhat smaller than the fruits of the Valencia strain, but have about the same shape; texture of skin very smooth, resembling in appearance that of fruits of the Smooth strain of the Washington Navel orange; color reddish orange; rind very thin; rag tender; juice abundant, sweet; seeds averaging 2 or 3 per fruit. This strain is promising as a valuable addition to the orange strains in California when isolated and improved by bud selection. It is frequently found as a limb sport in trees of the Valencia strain.

BARREN STRAIN.

The trees of the Barren strain show more than ordinary vegetative vigor, are very unproductive, and have a drooping habit of growth and very finely branched, dense foliage. The leaves are usually small, narrow, and very sharply pointed. One interesting condition of tree behavior in this strain is the tendency to produce an unusually large number of flowers during the blooming period.

The typical fruits occasionally produced by some trees of this strain, as shown in Plate VII, are flattened in shape, usually with a wrinkled appearance around the stem; size small; texture coarse; color yellowish orange; rind very thick; rag excessive, tough; juice scant, of very inferior quality; seeds averaging 1 or 2 per fruit. On account of its low production and the inferior commercial quality of its fruits, this strain is absolutely worthless. It is occasionally found as a limb sport in trees of the Valencia strain.

ROUGH STRAIN.

The trees of the Rough strain show more than ordinarily vigorous vegetative growth, with a tendency toward the production of a large number of suckers or abnormal branches, and bear smaller crops than trees of the Valencia strain. The habit of growth is usually upright and the foliage dense with large leaves. The large proportion of trees of this strain found in some Valencia orchards is probably due to the use of sucker growth in propagating the trees.

The typical fruits, as shown in Plate VIII, are globular; size large; texture coarse and rough; color yellowish orange; rind thick; rag tough; juice medium in quantity and quality; seeds averaging 2 or 3 per fruit. On account of the inferior appearance of these fruits they are of much less commercial value than those of the Valencia strain. They are occasionally found as limb sports in trees of the Valencia strain.

SPORTING STRAIN.

The trees of the Sporting strain are very variable in habit of growth and production, are usually of more than ordinarily vigorous vegetative growth, and have rather dense foliage. The leaves are extremely variable in size and shape.

The fruits, examples of which are shown in Plate IX, vary in a manner similar to the tree characteristics and frequently include examples of all of the observed strains of the variety and an unusual number of other forms, such as those showing raised or sunken sections, or both, sections of different strains of the Valencia oranges, peculiar ridges or depressions, and abnormal shapes. Usually but few fruits of the Valencia strain are borne by these trees, and on the whole, their crops are of very inferior value from a commercial standpoint.

FLAT STRAIN.

The trees of the Flat strain are comparatively unproductive, with an erect habit of growth and sparse foliage. The leaves are usually small and sharply pointed.

The typical fruits of this strain, as shown in Plate X, are distinctly flattened at both the stem and blossom ends, giving them a very characteristic appearance; size medium; texture coarse; color yellowish orange; rind thick; juice scant, of inferior quality; seeds averaging about 3 per fruit. On account of their shape, these fruits are not suitable for packing under prevailing conditions of marketing. This strain is frequently found as limb sports in trees of the Valencia strain.

NAVEL STRAIN.

The trees of the Navel strain have habits of growth and production similar to those of the Valencia strain. The foliage is usually rather dense; the leaves are small and rather pointed in shape.

The typical fruits, as shown in Plate XI, resemble the fruits of the Valencia strain in shape, size, and color, but differ from them in having a smoother texture of skin, thinner rind, more acid juice, fewer seeds, and a small, often rudimentary navel. This strain occurs occasionally as individual fruit and limb sports in trees of the Valencia strain. It has been isolated in commercial propagation and is grown to a limited extent under the name Navelencia orange. This strain is especially interesting from the fact that there is a possibility of isolating from it by bud selection a seedless strain of the Valencia variety.

WILLOW-LEAF STRAIN.

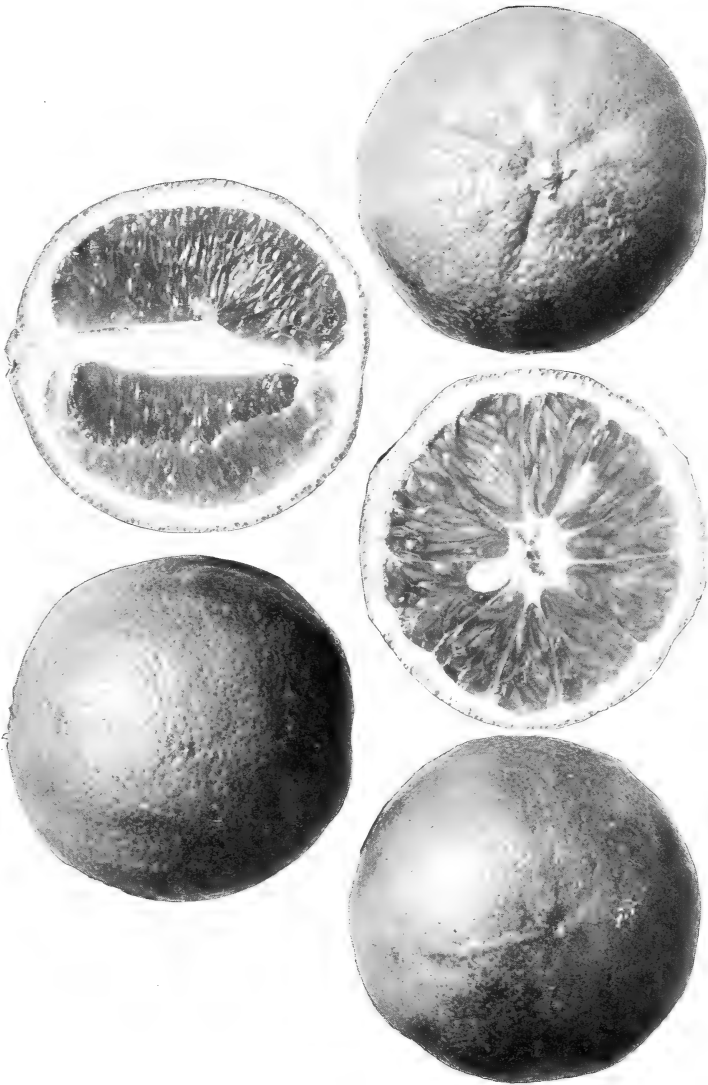
The trees of the Willow-Leaf strain have spreading and drooping habits of growth, very narrow, willowlike leaves, and produce infrequent, light crops of fruit.

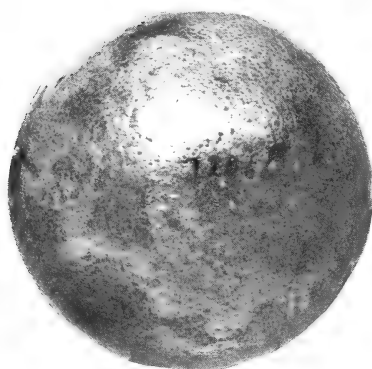
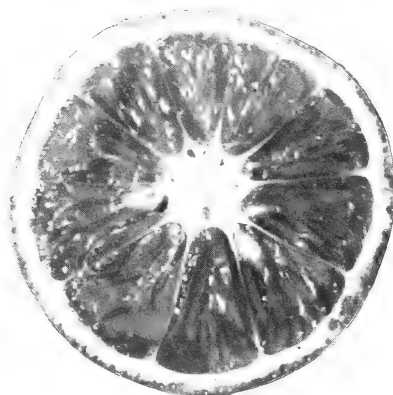
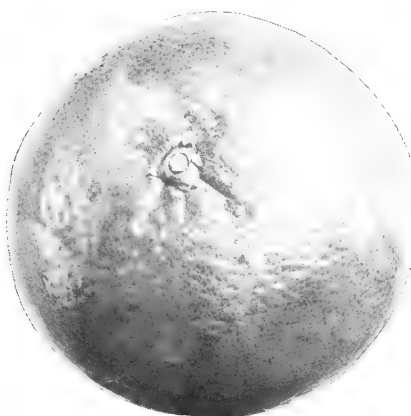
The typical fruits, as shown in Plate XII, are somewhat flattened; size usually small; color yellowish; texture of skin very coarse; rind thick, ridged, and uneven; rag coarse; juice scant, of poor quality; seeds averaging about 2 per fruit. This strain, while one of the most interesting bud variations found in this variety, is absolutely worthless for commercial purposes.

INDIVIDUAL VARIATIONS OF FRUITS.

The individual fruit variations found in trees of many of the Valencia orange strains are of fundamental importance in considering the origin of the various strains and their widespread distribution in young orchards. Under normal conditions a twig originating as a bud variation and bearing only a single variable fruit will in a few years develop into a large branch bearing the same character of fruit. In securing bud wood for propagation according to the methods which have prevailed in the past, no thought has been given to the possible occurrence in the trees of branches bearing fruits of variable strains, and as a result among trees so propagated there is usually found a considerable proportion of variable ones. On account of this previous lack of knowledge of the existence of variable strains, the percentage of such variable-strain trees in the population of any locality has been greatly increased with each bud generation. This fact is one of the most important reasons for securing individual-tree performance records and using such records as guides in the selection of trees from which to obtain bud wood for propagation.

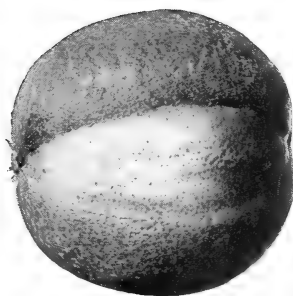
9379HP
TYPICAL FRUITS OF THE YELLOW STRAIN OF THE VALENCIA ORANGE, SHOWING ITS SHAPE, THE THICKNESS AND
TEXTURE OF THE RIND, AND OTHER CHARACTERISTICS.
(About three-fourths natural size.)





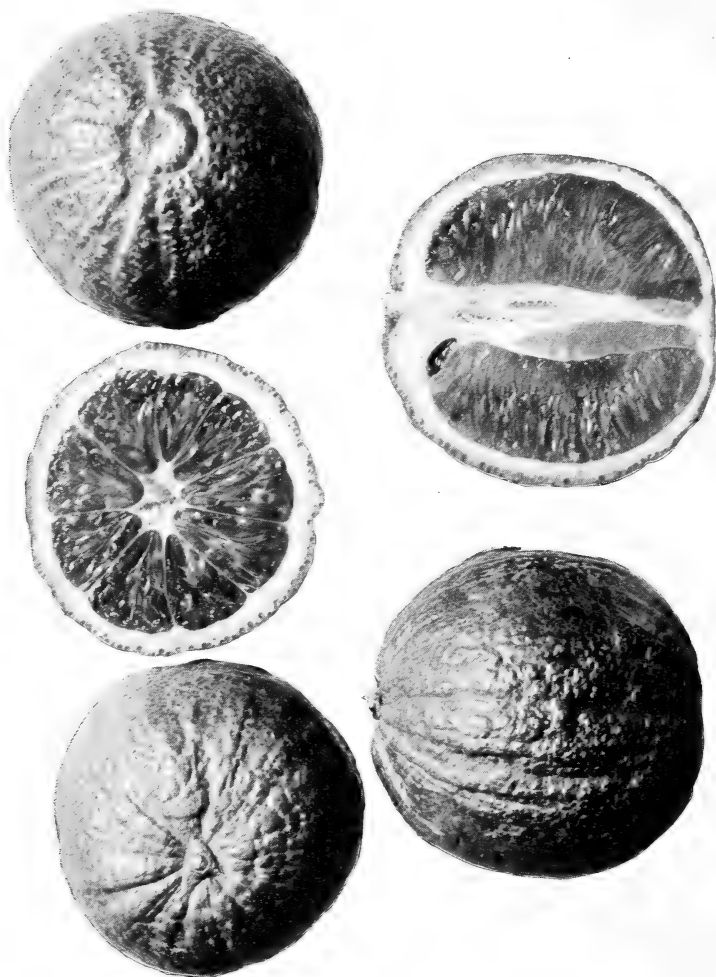
P1018A-HP AND P9295HP

TYPICAL FRUITS OF THE SMOOTH STRAIN OF THE VALENCIA ORANGE,
(About four-fifths natural size.)

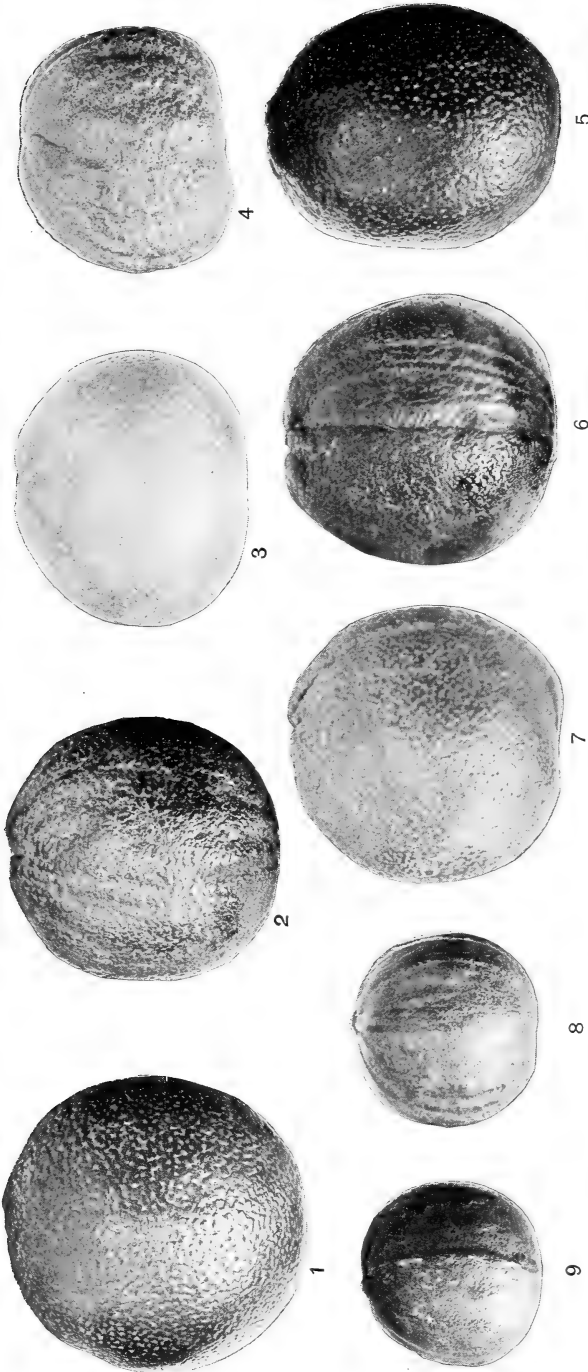


P1148HP
TYPICAL FRUITS OF THE BARREN STRAIN OF THE VALENCIA ORANGE, SHOWING THE CHARACTERISTIC
COARSE TEXTURE OF THE RIND AND ONE VARIABLE FRUIT.
(About three-fifths natural size.)

98276HP



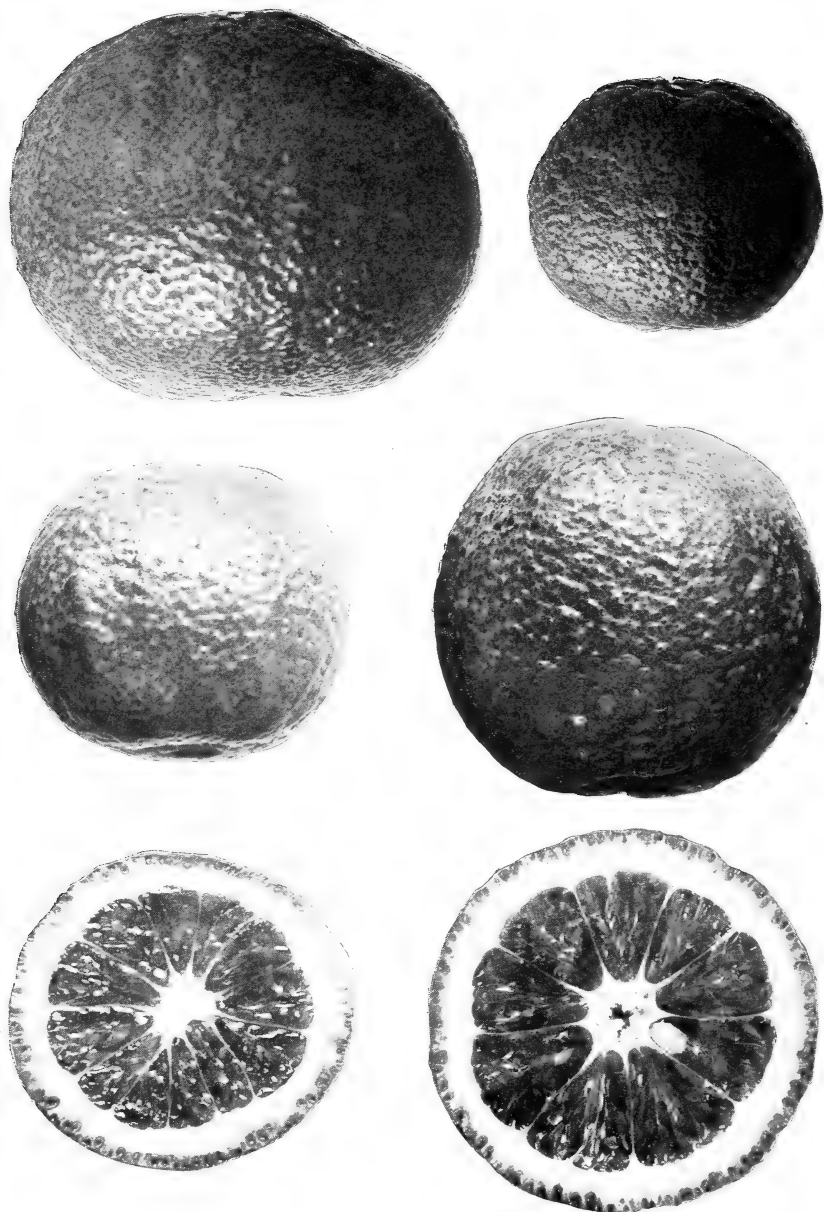
TYPICAL FRUITS OF THE ROUGH STRAIN OF THE VALENCIA ORANGE.
(About three-fifths natural size.)



FRUITS OF THE SPORTING STRAIN OF THE VALENCIA ORANGE, ALL BORNE ON ONE TREE GROWN FROM A SINGLE BUD.

1, Valencia strain; 2, Rough strain; 3, Flat strain; 4, Flat strain, corrugated; 5, Long strain; 6, Sunken section; 7, Raised section; 8, Ribbed strain; 9, Ridged section. (One-half natural size.)

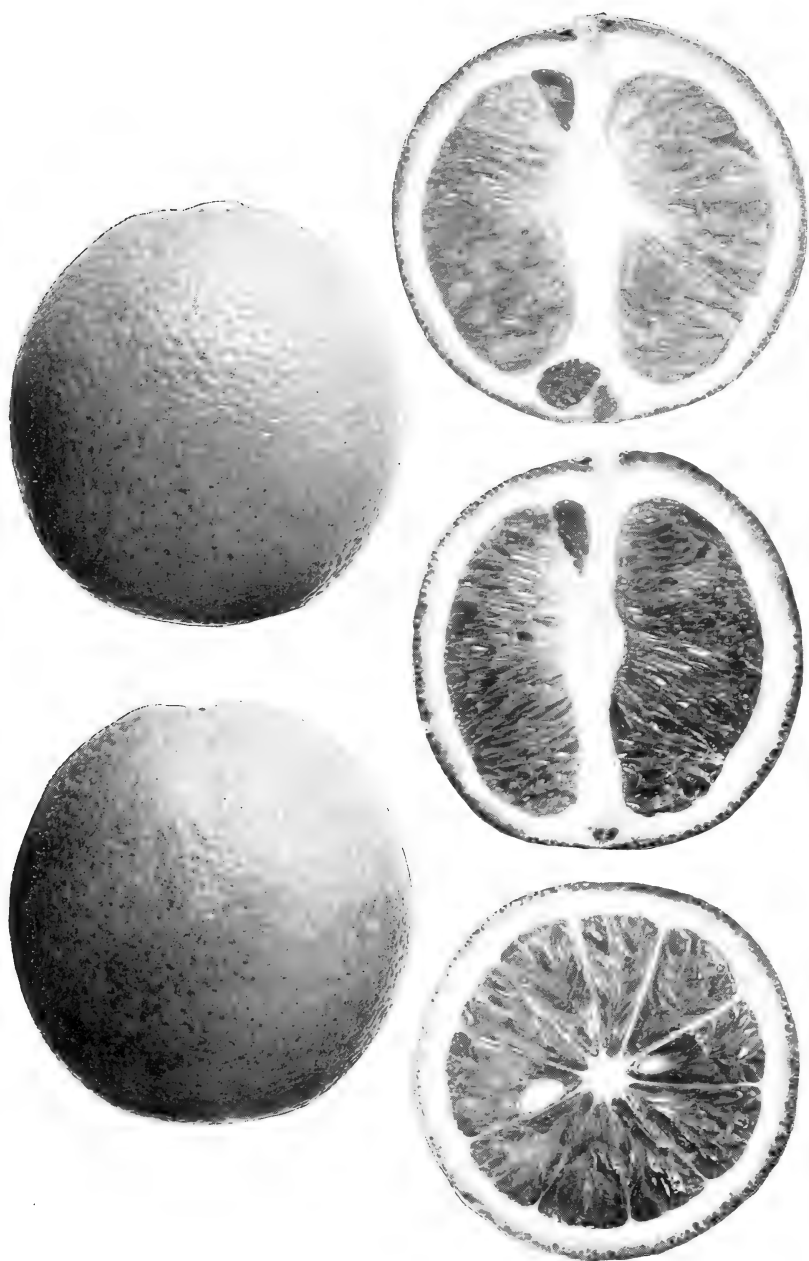
P221A-HP



P238A-HP, P1196A-HP, AND P1199A-HP

TYPICAL FRUITS OF THE FLAT STRAIN OF THE VALENCIA ORANGE.

(About four-fifths natural size.)



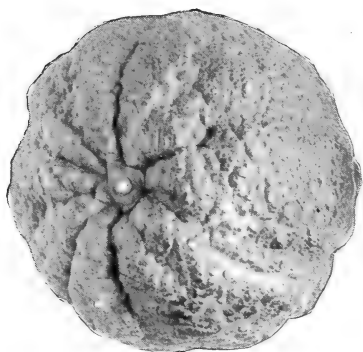
P134A-HP

TYPICAL FRUITS OF THE NAVEL STRAIN OF THE VALENCIA ORANGE.
(About four-fifths natural size.)



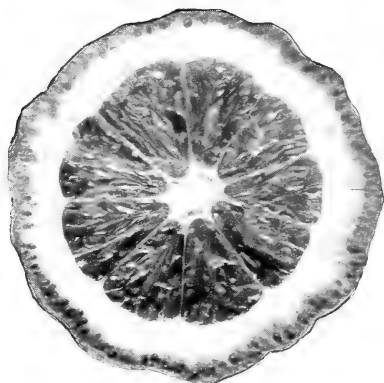
P214A-HP

FIG. 1.—SIDE VIEWS, SHOWING THE COARSE, ROUGH TEXTURE OF THE RIND.



P213A-HP

FIG. 2.—END VIEWS OF THE SAME FRUITS.

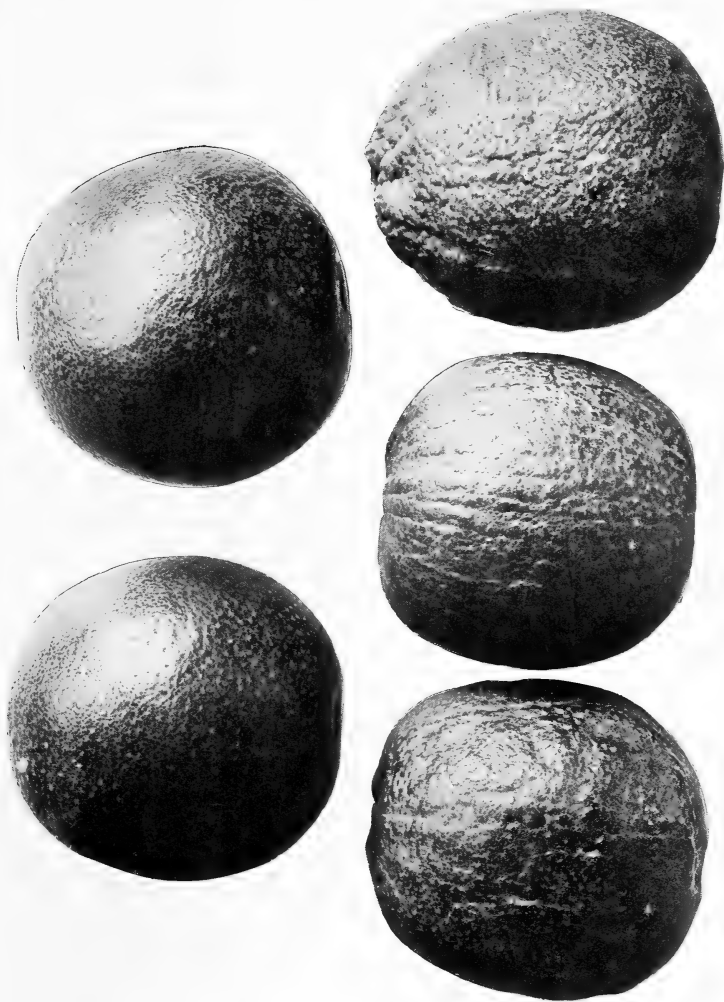


P215A-HP

FIG. 3.—CROSS SECTIONS OF THE SAME FRUITS.

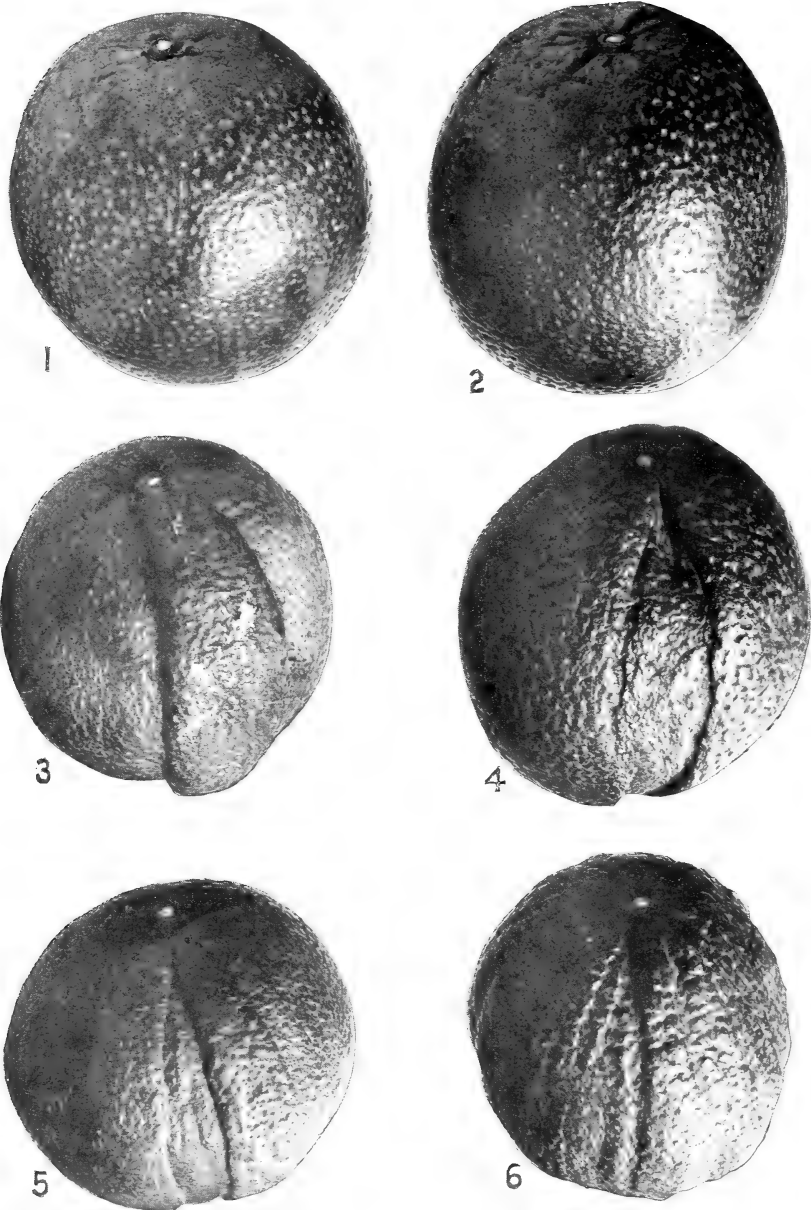
TYPICAL FRUITS OF THE WILLOW-LEAF STRAIN OF THE VALENCIA ORANGE.

(About two-thirds natural size.)



PL174A-HP
TYPICAL FRUITS OF THE VALENCIA AND ROUGH STRAINS OF THE VALENCIA ORANGE BORNE ON ONE TREE
GROWN FROM A SINGLE BUD.

The Rough-strain fruits were produced on a sporting limb, the remainder of the fruits on the tree being typical Valencia strain in character. (About three-fifths natural size.)



P458A-HP

MINOR VARIATIONS OF FRUITS BORNE ON A TREE OF THE VALENCIA STRAIN GROWN FROM A SINGLE BUD.

1 and 2, Valencia strain; 3, Raised section; 4, Sunken section; 5, Raised and Sunken sections; 6, Rough strain. (About seven-tenths natural size.)

Fruits arising from bud variations may occur as individual fruits, or collectively on a single branch, or on several branches of a single tree. Plate XIII shows fruits of the Rough strain which were borne on a sporting limb in a Valencia strain tree. The degree of fruit variability considered in this connection, while often of importance commercially, is usually not sufficient for varietal distinction. It may be illustrated by the variability of fruits in the Washington Navel orange where the variations under observation are well marked and commercially distinct but all of the fruits possess the characteristic navel. These strains possess characteristics which have been found to be capable of isolation through bud selection in propagation. The differences in the characteristics of the fruit variations in some of the different strains are of an importance from the commercial standpoint almost equal to those which differentiate the horticultural varieties of the citrus fruits.

The number of major fruit variations borne by individual Valencia trees in the performance-record plats differs greatly. A few trees have been found in the performance-record plats without any apparent or marked variations in fruits other than the usual modifications of size, shape, texture of rind, color, or quality which are probably due to the influence of environmental conditions. In some trees one or only a few variable fruits have been found. In others, several fruits of each of the 12 distinct strains have been found borne by one tree grown from a single bud. In some trees one of the main branches occasionally is found to bear fruit of several distinct strains, but as a rule single large off-type branches bear fruits of the same general character.

MINOR VARIATIONS OF FRUITS.

A great many minor variations have been found from year to year in some of the performance-record trees. A single fruit often shows sections or segments characteristic of two or more distinct strains of the variety. Others show large raised or sunken sections, or both, in the same fruit, examples of which are shown in Plate XIV. Many abnormal fruits, particularly in shape, have been found and described. Twin fruits, and those showing several divisions, each a complete orange in itself, have been found occasionally.

A careful study of these differences arising from bud variations is being made with the hope that the results will throw some light upon the problems of heredity in citrus varieties.

LESSONS TAUGHT BY THESE INVESTIGATIONS.

The tables and diagrams presented herewith are all prepared from records covering the 4-year period, 1912 to 1915, inclusive, secured from 105 trees in a grove which was planted in the fall of 1903. In

this plat there are typical trees of 8 of the 12 most important strains of the Valencia variety and 3 of the minor strains, as follows: 75 Valencia strain trees; 8 Unproductive; 7 Corrugated; 3 Sporting; 3 Coarse; 2 Rough; 2 Smooth; 2 Barren; 1 Long; 1 Yellow; and 1 Small Yellow. Examples of the other 4 important strains and several minor variations occur as bud and limb sports in many of the trees. Although this plat is not an example of extreme variation of strain in established orchards, it is interesting to note that only 71 per cent of the trees in it are of the Valencia strain. Groves have been observed which were found to contain as large a percentage, and in some extreme cases more than this proportion, of trees other than those of the Valencia strain.

The accompanying performance records, descriptions, and illustrations only partially present the characteristics of the various strains. The real differences of the trees and fruits must be seen and studied personally before they can be fully appreciated and their importance in commercial fruit growing understood. For this same reason, the selection of trees from which to secure bud wood for propagation should not be made on the basis of the performance records of the trees alone. It is most desirable that the final choice be made in the orchards with the performance records in hand by someone who through close study and observation of the trees themselves has gained an intimate knowledge of the interrelation of tree characteristics and crop production.

PRESENTATION OF DATA.

The complete 4-year performance records of the 105 trees on which comparable data have been secured are presented in Table I. This shows the production by weight and number of fruit of each grade and size for each year and the annual average production for the 4-year period. The basis of ranking the trees in this table is the average annual total crop of each tree, expressed in pounds and ounces, without regard to the grade, quality, or uniformity of the fruit. Hence, the position of any particular tree in this table is not necessarily a true index of what its relative position would be if the classification were made on the basis of the commercial value of its fruit. The impossibility of making an accurate classification of a large number of trees on the basis of the comparative quality of the fruits and the desirability of the individual trees is the reason for the adoption of the weight of the average annual crop as a basis in preparing this table.

[illegible]

TABLE 1.— Detailed statement of the annual performance of Valencia orange trees for which records were obtained for four years, 1912 to 1915, inclusive—Con.

Rank, tree number, strain, grade, and year.	Sizes.												Average number of seeds per fruit.	Number of variable fruits.										
	Total.		288 and smaller.		250		216		200		176				150		126		112		96		80 and larger.	
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.			Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.
9, tree No. 23-86-10, Valencia strain—Continued. Standard grade—	Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.	
1912.....	32 8	68	0 5	1	1 0	3	3 13	10	6 8	15	7 13	16	5 13	11	1 2	2	6 2	10	0 0	0	0 0	0	0 0	
1913.....	25 13	114	19 4	96	3 4	11	1 1	3	0 0	0	0 0	0	1 10	3	0 0	0	0 10	1	0 0	0	0 0	0	3 33	
1914.....	15 4	52	9 13	37	3 7	10	1 9	4	0 7	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	3 33	
1915.....	32 5	107	12 0	46	13 2	42	5 8	15	1 4	3	0 7	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	7 00	
Average.....	26.5	85	10.3	45	5.2	17	3.0	8	2.1	5	1.1	4	1.9	4	0.3	0.5	1.7	3	0	0	0	0	3.58	
Cull fruits—																								
1912.....	12 5	26																					1.67	
1913.....	5 1	69																					4.00	
1914.....	2 0	12																					3.67	
1915.....	2 2	10																					7.67	
Average.....	5.4	29																					4.25	
Total crop—																								
1912.....	145 1	293	0 15	3	2 5	7	7 13	21	18 5	43	19 11	42	44 9	86	7 7	13	28 7	47	3 4	5	0 0	0	1 22	0
1913.....	150 8	585	57 15	258	45 3	145	19 3	65	19 8	51	0 7	1	2 9	5	0 0	0	0 10	1	0 0	0	0 0	0	3 67	0
1914.....	152 15	457	68 1	228	48 9	134	27 0	67	5 12	13	1 9	3	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	3 11	6
1915.....	197 1	592	21 14	84	34 10	116	50 3	152	72 7	194	12 15	30	2 14	6	0 0	0	0 0	0	0 0	0	0 0	0	6 78	1
Average.....	161.4	482	37.2	143	32.7	101	26.0	74	29.0	75	8.7	19	12.5	24	1.9	3	7.3	12	0.8	1	0	0	3.69	2
10, tree No. 23-86-5, Valencia strain— Orchard grade—																								
1912.....	100 2	280	10 15	43	20 15	67	17 11	50	28 1	72	12 5	28	6 3	13	1 0	2	1 12	3	1 4	2	0 0	0	1 33	...
1913.....	136 1	469	63 6	258	43 1	134	13 8	38	10 15	28	3 11	8	1 8	3	0 0	0	0 0	0	0 0	0	0 0	0	3 67	...
1914.....	88 1	240	30 0	95	27 8	74	19 14	48	7 10	17	2 10	4	1 1	2	0 0	0	0 0	0	0 0	0	0 0	0	5 23	...
1915.....	147 9	408	3 1	12	11 9	39	36 6	110	73 0	194	17 2	40	5 6	11	1 1	2	0 0	0	0 0	0	0 0	0	7 33	...
Average.....	118.0	349	26.8	102	25.8	79	21.9	62	29.9	78	8.8	20	3.5	7	0.5	1	0.4	1	0.3	0.5	0	0	4.44	...

TABLE I.—Detailed statement of the annual performance of Valencia orange trees for which records were obtained for four years, 1912 to 1915, inclusive—Con.

Rank, tree number, strain, grade, and year.	Sizes.																								Average number of seeds per fruit.	Number of variable fruits.
	Total.		288 and smaller.		250		216		200		176		150		126		112		96		80 and larger.					
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.				
24, tree No. 23-86-6, Valencia strain—Continued. Standard grade—	Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.			
	51 15	104	0 9	2	0 11	12	4 10	12	11 7	26	8 12	18	14 8	26	2 6	4	9 0	14	0 0	0	0 0	0	0 33			
	35 7	160	28 0	137	4 12	16	1 12	5	0 6	1	0 9	1	0 8	1	0 0	0	0 0	0	0 0	0	0 0	0	0 33			
	18 3	52	5 3	19	4 14	14	2 12	7	3 7	8	1 7	3	0 8	1	0 0	0	0 0	0	0 0	0	0 0	0	0 33			
	44 4	139	15 2	57	10 8	33	10 1	28	5 11	14	2 6	6	0 8	1	0 0	0	0 0	0	0 0	0	0 0	0	2 00			
Average.....	37.5	114	12.2	54	5.2	16	4.8	13	5.2	12	3.3	7	3.9	7	0.6	1	2.3	4	0	0	0	0	2 25			
Cull fruits—																										
	9 7	17																								
	5 5	54																					1 00			
	1 14	12																					5.33			
	3 6	13																					4.33			
Average.....	5.0	24																					3.33			
Total crop—																								3.50		
	118 3	233	0 13	3	1 0	3	5 6	14	22 5	52	22 10	47	28 4	52	7 12	13	17 2	27	3 8	5	0 0	0	0 56	9 9		
	140 13	581	74 3	323	41 14	136	13 12	39	9 13	25	1 14	4	0 0	2	0 0	0	0 0	0	0 0	0	0 0	0	0 3 67	17 9		
	117 8	301	15 15	52	30 8	82	37 4	89	20 15	45	10 19	1	0 0	2	0 0	0	0 0	0	0 0	0	0 0	0	0 4 22	31 31		
	199 0	583	19 10	75	28 8	96	54 1	161	68 3	180	20 14	48	3 13	8	0 9	1	0 0	0	0 0	0	0 0	0	0 3 22	17 31		
Average.....	145.4	425	27.6	113	25.5	79	27.6	76	30.3	76	13.8	30	8.3	16	2.1	4	4.3	7	0.9	1	0	0	2.92	17 17		
25, tree No. 23-87-9, Valencia strain: Orchard grade—																										
	77 14	173	1 0	4	4 3	13	5 8	15	16 14	42	17 6	38	21 3	42	4 11	8	3 10	6	3 7	5	0 0	0	0	0 2 00		
	99 9	348	41 12	177	28 4	93	12 8	36	12 5	32	3 10	8	0 8	1	0 0	0	0 10	1	0 0	0	0 0	0	0 3 67	17 9		
	83 3	242	21 0	66	28 1	75	28 12	69	11 10	25	3 12	7	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 3 67	17 9		
	140 4	406	12 4	46	27 7	91	33 4	97	52 11	140	10 5	24	4 5	9	0 0	0	0 0	0	0 0	0	0 0	0	0 5 33	31 31		
Average.....	102.7	292	19.0	73	22.0	68	20.0	54	23.4	60	8.8	19	6.5	13	1.2	2	1.1	2	0.9	1	0	0	2.75	17 17		

TABLE I.—Detailed statement of the annual performance of Valencia orange trees for which records were obtained for four years, 1912 to 1915, inclusive—Con.

Rank, tree number, strain, grade, and year.	Sizes.																						Average number of seeds per fruit.	Number of variable fruits.
	Total.		288 and smaller.		250		216		200		176		150		126		112		96		80 and larger.			
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.		
39, tree No. 23-76-17, Valencia strain—Continued. Standard grade—	Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.	
	19 7	45	0 15	3	1 6	4	1 10	4	6 8	16	3 14	8	4 9	9	0 9	1	0 0	0	0 0	0	0 0	0	0 33	
	25 7	109	2 4	92	4 7	15	0 10	2	0 0	0	0 15	2	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	4.00	
	11 3	33	2 4	9	5 1	15	0 12	2	2 3	5	0 15	2	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	4.00	
	32 7	101	2 14	13	11 0	37	9 10	28	7 10	20	0 13	2	0 0	0	0 8	1	0 0	0	0 0	0	0 0	0	4.67	
	Average.....	22.1	6.6	29	5.5	18	3.2	9	4.1	10	1.4	3	1.1	2	0.3	0.5	0	0	0	0	0	0	3.25	
Cull fruits—																								
	0 5	2																					0	
	4 11	63																					4.67	
	0 8	3																					3.00	
	2 7	13																					4.00	
	Average.....	2.0	20																				2.92	
Total crop—																								
	101 14	230	1 3	4	4 1	13	6 12	19	22 12	57	23 13	52	30 9	61	6 11	12	5 2	9	6 10	1	0 0	0	0.71	
	147 10	551	54 13	225	47 14	152	23 15	69	15 14	41	0 7	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	4.11	
	104 7	271	17 4	57	24 13	69	30 6	74	25 1	55	4 13	10	1 10	3	0 0	0	0 0	0	0 0	0	0 0	0	3.56	
	162 12	450	5 6	22	24 2	79	33 14	98	62 12	162	20 6	47	11 4	24	2 9	5	0 0	0	0 0	0	0 0	0	5.11	
	Average.....	129.2	376	19.7	77	25.2	78	23.7	65	31.6	79	12.4	28	10.9	22	2.3	4	1.3	2	0.2	0.3	0	3.33	
40, tree No. 23-76-18, Corru- gated strain: Orchard grade—																								
	35 0	93	1 0	4	5 3	17	8 7	24	10 12	27	7 1	16	2 9	5	0 0	0	0 0	0	0 0	0	0 0	0	2.00	
	38 1	116	8 7	32	11 12	37	9 7	27	7 8	18	0 15	2	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	2.67	
	42 3	122	16 14	57	11 12	32	8 4	21	3 13	9	1 8	3	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	5.00	
	34 8	81	0 3	1	0 9	2	3 4	9	12 8	31	8 14	20	8 0	16	1 2	2	0 0	0	0 0	0	0 0	0	4.67	
	Average.....	37.4	103	6.6	24	7.4	22	7.3	20	8.6	21	4.6	10	2.6	5	0.3	0.5	0	0	0	0	0	3.59	

Total crop—	1912.....	124 11	285	5 7	17	5 1	15	10 0	27	26 0	62	23 0	50	29 5	58	3 2	6	9 0	15	1 15	3	0 0	0	1 00	6	
	1913.....	128 15	594	73 5	324	30 10	99	10 0	28	6 0	15	1 8	3	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	2 11	7	
	1914.....	142 14	404	78 8	283	39 0	112	18 4	47	4 13	11	0 8	1	0 9	1	0 0	4	1 5	2	0 0	0	0 0	0	5 33	136	
	1915.....	105 1	287	4 7	19	18 0	59	20 12	60	34 43	89	15 1	34	6 15	14	2 4	4	1 5	2	0 0	0	0 0	0	3 67	45	
	Average.....	125.4	408	40.4	161	23.2	71	14.8	41	17.9	44	10.0	22	9.2	18	1.3	3	2.6	4	0.5	1	0	0	3.04	49	
43, tree No. 23-93-8, Valencia strain:																										
Orchard grade—	1912.....	37 7	70	0 4	1	0 0	0	0 12	2	6 2	14	2 12	6	9 6	18	1 11	3	9 10	16	6 14	10	0 0	0	0	....
	1913.....	87 2	260	11 15	49	27 4	88	17 5	50	18 1	46	9 8	21	2 8	5	0 0	0 9	1	0 0	0	0 0	0	0	2 00	....
	1914.....	101 1	277	27 5	91	27 4	77	27 0	68	15 4	33	2 0	4	2 4	4	0 0	0 0	0	0 0	0	0 0	0	0	2 67	....
	1915.....	138 3	353	5 13	20	9 9	29	22 6	64	63 3	160	22 9	51	10 11	22	4 0	7	0 0	0	0 0	0	0 0	0	4 00	....
	Average.....	91.0	240	11.3	40	16.0	49	16.9	46	25.7	63	9.2	21	6.2	12	1.4	3	2.5	4	1.7	3	0	0	2.17	....
Standard grade—	1912.....	31 7	62	0 4	1	1 0	3	1 2	3	3 4	8	4 4	9	10 5	19	2 12	5	8 8	14	0 0	0	0 0	0	0	33
	1913.....	30 0	113	17 6	75	7 8	24	3 15	11	1 3	3	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	1 00	....
	1914.....	19 0	63	11 11	44	3 15	12	1 4	3	0 7	1	0 8	1	0 9	1	0 10	1	0 0	0	0 0	0	0 0	0	5 09	....
	1915.....	41 13	120	3 5	13	10 0	33	14 3	40	7 3	18	6 2	11	1 0	2	0 0	0	0 0	0	0 0	0	0 0	0	3 33	....
	Average.....	30.6	90	8.2	33	5.6	18	5.1	14	3.0	8	2.9	6	3.0	6	0.8	2	2.1	4	0	0	0	0	2.42	....
Cull fruits—	1912.....	7 1	11	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	1913.....	3 13	46	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	1914.....	1 10	8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	1915.....	2 4	10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Average.....	3.7	19	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Total crop—	1912.....	75 15	143	0 8	2	1 0	3	1 14	5	9 6	22	7 0	15	19 11	37	4 7	8	18 2	30	6 14	10	0 0	0	56	1	
	1913.....	120 15	419	29 5	124	34 12	112	21 4	61	19 4	49	9 8	21	2 8	5	0 0	0 9	1	0 0	0	0 0	0	0	1 78	0	
	1914.....	121 11	348	39 0	135	31 3	89	28 4	71	15 11	34	2 8	5	2 13	5	0 10	1	0 0	0	0 0	0	0	0	3 11	1	
	1915.....	182 4	483	9 2	33	19 9	62	36 9	104	70 6	178	28 11	65	11 11	24	4 0	7	0 0	0	0 0	0	0	0	3 33	2	
	Average.....	125.2	348	19.5	74	21.6	67	22.0	60	28.7	71	11.9	27	9.2	18	2.3	4	4.7	8	1.7	3	0	0	2.19	1	
44, tree No. 23-90-7, Sporting strain:	1912.....	44 1	93	0 9	2	1 10	5	0 7	1	9 6	23	9 0	20	10 1	20	3 4	6	5 11	10	4 1	6	0 0	0	2 00	....
	1913.....	75 12	257	27 4	114	24 11	80	10 7	30	9 3	24	2 11	6	1 8	3	0 0	0 0	0	0 0	0	0 0	0	0	2 00	....
	1914.....	66 14	168	11 0	35	14 2	39	17 15	44	16 8	36	5 9	11	1 12	3	0 0	0 0	0	0 0	0	0 0	0	0	2 00	....
	1915.....	44 3	115	0 12	3	4 12	15	7 2	21	15 6	40	10 0	23	5 10	12	0 9	1	0 0	0	0 0	0	0 0	0	3 00	....
	Average.....	57.7	158	9.9	39	11.3	35	9.0	24	12.6	31	6.8	15	4.7	10	1.0	2	1.4	3	1.0	2	0	0	2.25	....

TABLE I.—Detailed statement of the annual performance of Valencia orange trees for which records were obtained for four years, 1912 to 1915, inclusive—Con.

Rank, tree number, strain, grade, and year.	Sizes.																Average number of seeds per fruit.	Number of variable fruits.				
	Total.		288 and smaller.		250		216		200		176		150		126				112		96		80 and larger.
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.
44, tree No. 23-90-7, Sporting strain—Continued. Standard grade— 1912..... 1913..... 1914..... 1915..... Average.....	Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.	
	49 12	104	1 10	6	1 12	5	4 6	12	6 11	16	0 7	14	13 8	25	1 1	2	14 5	24	0 0	0	0 0	0
	35 12	158	27 11	135	4 3	14	1 15	5	0 8	1	0 6	1	1 1	2	0 0	0	0 0	0	0 0	0	0 0	0
	52 5	140	9 2	34	10 3	31	8 2	22	23 8	24	7 6	16	4 8	9	0 9	1	0 10	1	1 14	3	0 0	0
	78 8	232	4 12	20	15 0	50	19 8	66	20 3	60	13 0	30	2 8	5	0 9	1	0 0	0	0 0	0	0 0	0
	54.1	159	10.8	49	7.8	25	8.5	23	10.2	25	6.8	15	5.4	10	0.4	1	3.9	6	0.5	1	0	0
Cull fruits— 1912..... 1913..... 1914..... 1915..... Average.....																						
	46 8	101																				
	4 1	61																				
	1 1	5																				
	2 0	11																				
	13.4	46																				
Total crop— 1912..... 1913..... 1914..... 1915..... Average.....																						
	140 5	301	2 3	8	3 6	10	4 13	13	16 1	39	15 7	34	23 9	45	4 5	8	20 0	34	4 1	6	0 0	0
	115 9	479	54 15	219	28 14	94	12 6	35	9 11	25	3 1	7	2 9	5	0 0	0	0 0	0	0 0	0	0 0	0
	120 4	313	20 2	69	24 5	70	26 1	66	27 0	60	12 15	27	6 4	12	0 0	0	0 10	1	1 14	3	0 0	0
	124 11	358	5 8	23	19 12	65	26 10	87	38 9	100	23 0	53	8 2	17	1 2	2	0 0	0	0 0	0	0 0	0
	125.2	363	20.7	87	19.1	60	17.5	50	22.8	56	13.6	30	10.1	20	1.3	3	5.2	9	1.5	2	0	0
45, tree No. 23-91-7, Valencia strain: Orchard grade— 1912..... 1913..... 1914..... 1915..... Average.....																						
	37 9	82	1 5	5	2 4	7	2 3	6	6 15	17	4 14	11	9 4	19	0 9	1	3 9	6	6 10	10	0 0	0
	88 12	290	33 0	138	30 11	97	7 2	21	11 13	30	3 15	9	1 9	3	0 0	0	0 10	1	0 0	0	0 0	0
	74 5	214	22 6	77	26 6	75	14 9	37	10 8	24	0 8	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0
	53 6	141	2 4	8	4 8	14	9 6	27	23 13	62	11 8	26	1 15	4	0 0	0	0 0	0	0 0	0	0 0	0
	63.5	184	14.7	57	16.0	48	8.3	23	13.3	33	5.2	12	3.2	7	0.1	0.3	1.1	2	1.7	3	0	0

TABLE I.—Detailed statement of the annual performance of Valencia orange trees for which records were obtained for four years, 1912 to 1915, inclusive—Con.

Rank, tree number, strain, grade, and year.	Sizes.																						Average number of seeds per fruit.	Number of variable fruits.
	Total.		288 and smaller.		250		216		200		176		150		126		112		96		80 and larger.			
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.		
54, tree No. 23-86-8, Valencia strain—Continued. Standard grade—	Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.	
	29 5	56	0 4	1	1 1	3	0 14	2	4 7	10	6 7	13	5 11	10	1 12	3	8 13	14	0 0	0	0 0	0	0 0	
	28 2	117	20 9	94	3 11	13	2 9	7	0 6	1	0 7	1	0 8	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0	
	9 14	26	2 10	9	1 6	4	1 8	4	1 12	4	0 8	1	2 2	4	0 0	0	0 0	0	0 0	0	0 0	0	0 0	
	47 10	189	35 8	150	9 12	32	2 0	6	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	
	Average.....	28.7	97	14.7	64	4.0	13	1.7	5	1.6	4	1.8	4	2.1	4	0.4	1	2.2	4	0	0	0	0	2.59
Cull fruits—																								
	9 1	16																						
	7 14	79																					0	
	0 6	2																					2.00	
	2 7	13																					3.33	
	Average.....	4.9	28																					5.00
Total crop—																								2.58
	79 0	148	0 8	2	1 12	5	2 5	6	7 5	17	12 6	25	16 7	31	4 2	7	18 1	29	7 1	10	0 0	0	0	0.44
	118 7	479	52 13	227	27 5	91	13 13	39	13 15	37	2 3	5	0 8	1	0 0	0	0 0	0	0 0	0	0 0	0	0	2.00
	68 14	162	7 8	23	12 12	34	14 10	35	19 12	42	10 10	20	2 10	5	0 0	0	0 10	1	0 0	0	0 0	0	0	3.00
	215 6	755	64 12	272	55 14	196	48 5	152	41 2	115	2 14	7	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0	4.44
	Average.....	120.4	366	31.4	131	24.4	82	19.8	58	20.5	53	7.0	14	4.9	9	1.0	2	4.7	8	1.8	3	0	0	2.47
55, tree No. 23-87-4, Valencia strain: Orchard grade—																								
	69 7	156	1 10	6	4 4	13	6 10	18	16 2	38	7 0	37	16 8	32	1 11	3	4 14	8	0 12	1	0 0	0	0	2.00
	56 2	180	17 8	73	12 13	41	9 0	25	12 4	31	3 2	7	1 7	3	0 0	0	0 0	0	0 0	0	0 0	0	0	2.00
	106 7	307	39 8	130	37 5	104	22 14	58	5 14	13	0 14	2	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0	3.67
	111 5	306	5 11	21	16 6	52	27 9	80	45 4	116	12 11	29	3 12	8	0 0	0	0 0	0	0 0	0	0 0	0	0	5.67
	Average.....	85.8	237	16.1	58	17.7	53	16.5	45	19.9	50	5.9	19	5.4	11	0.4	1	1.2	2	0.2	0.3	0	0	3.33

Standard grade—	1912.....	36 11	80	1 7	5	1 12	5	5 5	14	9 1	21	7 15	16	5 10	10	0 9	1	5 0	8	0 0	0 0	0 0	0 0	0 0	0 0	1 67
	1913.....	37 10	79	14 5	68	3 10	10	0 5	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	5 33
	1914.....	29 5	98	1 1	35	8 10	26	4 6	12	1 4	0	0 8	1	0 8	1	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	6 33
	1915.....	31 5	99	5 5	21	13 10	44	8 7	24	3 0	8	0 7	1	0 8	1	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	6 33
	Average.....	28.7	89	8.8	37	6.8	21	4.6	13	3.3	8	2.2	5	1.7	3	0.1	0.3	1.3	2	0	0	0	0	0	0	3.42
Cull fruits—	1912.....	11 0	22																							3.00
	1913.....	3 9	41																							1.67
	1914.....	3 6	18																							3.67
	1915.....	4 8	16																							4.33
	Average.....	5.6	24																							3.17
Total crop—	1912.....	117 2	258	3 1	11	6 0	18	11 15	32	25 3	59	24 15	53	22 2	42	2 4	4	9 14	16	0 12	1	0 0	0 0	0 0	0 0	2 22
	1913.....	77 5	300	31 13	141	15 13	51	9 5	26	12 4	31	3 2	7	1 7	3	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	1 33
	1914.....	139 2	423	53 9	185	45 15	130	27 4	70	7 2	16	1 6	3	0 8	1	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	4 22
	1915.....	147 2	421	11 0	42	30 0	96	36 0	104	48 4	124	13 2	30	4 4	9	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	5 44
	Average.....	120.2	351	24.9	95	24.4	74	21.1	58	23.2	59	10.6	23	7.1	13	0.6	1	2.5	4	0.2	0.3	0	0	0	0	3.30
56, tree No. 23-86-9, Valencia strain—	1912.....	76 10	167	0 9	2	2 4	7	7 0	19	23 3	55	13 7	28	22 7	43	2 2	4	2 14	5	2 12	4	0 0	0 0	0 0	0 0	0 67
	1913.....	76 4	257	31 6	127	23 1	73	9 10	27	10 6	26	1 13	4	0 0	0	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	3 33
	1914.....	101 3	271	32 14	104	27 11	74	23 6	56	15 6	33	1 14	4	0 0	0	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	3 00
	1915.....	133 14	380	5 12	23	16 2	54	38 3	114	53 0	142	16 2	37	4 11	10	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	4 00
	Average.....	97.0	269	17.6	64	17.3	52	19.5	54	25.5	64	8.3	18	6.8	13	0.5	1	0.7	1	0.7	1	0	0	0	0	2.75
Standard grade—	1912.....	33 0	73	1 5	5	1 6	4	3 13	10	10 12	24	6 3	13	5 13	11	0 0	0	3 12	6	0 0	0	0 0	0 0	0 0	0 0	3 00
	1913.....	23 6	102	21 0	95	1 8	5	0 6	1	0 8	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	2 67
	1914.....	7 2	23	3 2	13	0 15	3	0 12	2	1 5	3	1 0	2	0 0	0	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	4 33
	1915.....	16 12	58	7 12	30	6 4	20	2 6	7	0 6	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0 0	0 0	0 0	0 0	0 0	5 33
	Average.....	20.1	64	8.3	36	2.5	8	1.8	* 5	3.2	7	1.8	4	1.5	3	0	0	0.9	2	0	0	0	0	0	0	3.83
Cull fruits—	1912.....	1 12	24																							1.00
	1913.....	3 6	45																							2.00
	1914.....	1 8	9																							3.33
	1915.....	2 1	11																							5.33
	Average.....	2.2	22																							2.92

56, tree No. 23-86-9, Valencia strain—

Orchard grade—

TABLE I.—Detailed statement of the annual performance of Valencia orange trees for which records were obtained for four years, 1912 to 1915, inclusive—Con.

Rank, tree number, strain, grade, and year.	Sizes.																						Average number of seeds per fruit.	Number of variable fruits.
	Total.		288 and smaller.		250		216		200		176		150		126		112		96		80 and larger.			
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.		
59, tree No. 23-88-9, Valencia strain—Continued— Standard grade—	Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.		Lbs. oz.			
1912.....	35 5	79	1 14	7	2 6	7	2 4	6	5 2	12	5 0	11	15 3	29	1 2	3	2 6	4	0 0	0	0 0	0		
1913.....	24 2	121	20 6	109	1 11	6	1 9	5	0 0	0	0 8	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0		
1914.....	22 8	67	9 0	33	5 8	16	3 8	9	2 4	5	0 8	1	1 2	2	0 0	0	0 10	1	0 0	0	0 0	0		
1915.....	29 8	90	4 9	17	12 6	40	3 5	9	6 1	15	0 15	2	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0		
Average.....	27.9	89	9.0	42	5.5	17	3.2	9	3.4	8	1.7	4	4.1	8	0.3	1	0.8	1	0	0	0	5.00		
Cull fruits—																								
1912.....	8 14	23																				0		
1913.....	3 11	57																				4.33		
1914.....	1 7	8																				4.00		
1915.....	0 12	6																				4.33		
Average.....	3.7	21																				3.17		
Total crop—																								
1912.....	122 10	282	3 0	11	10 7	32	8 10	23	23 7	59	19 8	42	36 15	71	2 12	6	7 2	12	1 15	3	0 0	0		
1913.....	113 12	484	62 12	285	28 15	93	11 2	32	4 14	12	2 6	5	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0		
1914.....	110 5	310	30 14	105	40 3	110	23 4	57	9 11	21	3 2	6	1 2	2	0 0	0	0 10	1	0 0	0	0 0	0		
1915.....	128 1	356	9 3	34	23 2	74	24 9	71	48 9	124	11 2	25	8 1	17	2 11	5	0 0	0	0 0	0	0 0	0		
Average.....	118.7	353	26.5	109	27.7	77	16.9	45	21.6	54	9.0	20	11.5	23	1.4	3	1.9	3	0.5	1	0	0		
60, tree No. 23-92-2, Valencia strain— Orchard grade—																								
1912.....	37 6	76	0 4	1	0 10	2	2 10	7	5 6	13	5 6	12	8 11	17	3 5	6	6 8	11	4 10	7	0 0	0		
1913.....	58 6	200	22 6	94	15 12	51	11 1	32	6 10	17	2 1	5	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0		
1914.....	104 4	333	53 0	198	50 4	87	14 0	36	4 0	10	1 0	2	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0		
1915.....	73 1	214	6 10	24	15 12	53	17 10	53	27 0	72	5 3	12	0 14	2	0 0	0	0 0	0	0 0	0	0 0	0		
Average.....	68.3	206	21.1	79	20.6	48	11.3	32	10.8	28	3.4	8	2.5	5	0.8	2	1.6	3	1.2	2	0	0		

Total crop—	109 10	234	4	4	15	3	7	10	8	2	22	19	9	47	19	9	41	19	12	38	6	0	11	16	7	27	4	0	0	0	0	1.11	0	
1912.....	124	1	523	48	12	211	42	10	134	17	15	50	14	10	37	4	2	9	1	0	2	0	0	0	0	0	0	0	0	0	0	3.89	2	
1913.....	106	15	237	27	10	91	34	10	60	17	4	38	1	0	2	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4.22	3	
1914.....	112	14	235	1	4	6	9	9	30	20	13	59	47	6	121	20	15	48	9	13	21	2	4	0	0	0	0	0	0	0	0	5.67	3	
1915.....																																		
Average.....	115.9	337	20.5	81	22.6	67	17.9	48	24.7	61	11.4	25	7.8	16	2.0	4	4.1	7	1.0	2	0	0	0	0	0	0	0	0	0	0	0	3.72	2	
63, tree No. 23-76-20, Sporting strain:																																		
Orchard grade—																																		
1912.....	49	4	95	0	0	0	1	6	4	1	14	5	5	0	12	7	14	17	15	5	29	2	6	4	10	7	17	5	0	0	0	.67	...	
1913.....	92	12	298	26	6	104	28	1	91	18	13	54	15	8	40	3	7	8	0	9	1	0	0	0	0	0	0	0	0	0	0	0	4.67	...
1914.....	90	12	254	30	3	99	29	7	81	21	52	8	8	19	1	0	2	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	2.67	...
1915.....	92	9	247	5	5	19	13	15	43	18	14	54	37	10	94	13	5	30	2	15	6	0	9	1	0	0	0	0	0	0	0	0	5.67	...
Average.....	51.3	224	15.5	56	18.2	55	15.2	41	16.7	41	6.4	14	4.8	9	0.7	1	2.6	4	1.3	2	0	0	0	0	0	0	0	0	0	0	0	3.42	...	
Standard grade—																																		
1912.....	26	3	52	0	15	3	0	0	0	2	0	5	2	2	5	4	7	9	10	11	20	2	4	4	3	12	6	0	0	0	0	0	.67	...
1913.....	22	6	98	16	5	80	3	2	10	1	6	4	1	3	3	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.67	...
1914.....	32	12	106	13	15	53	11	8	34	4	6	12	2	7	6	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.67	...
1915.....	35	10	117	6	8	31	12	5	41	9	3	27	4	11	12	2	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.33	...
Average.....	29.2	93	9.4	42	6.7	21	4.2	12	2.6	7	1.9	4	2.7	5	0.7	1	0.9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.59	...
Cull fruits—																																		
1912.....	12	9	24																														1.33	...
1913.....	3	15	36																														2.00	...
1914.....	1	0	7																														2.33	...
1915.....	3	8	16																														4.67	...
Average.....	5.3	21																															2.58	...
Total crop—																																		
1912.....	88	0	171	0	15	3	1	6	4	3	14	10	7	2	17	12	5	26	0	49	4	10	8	14	3	23	5	0	0	0	0	.89	0	
1913.....	119	1	432	42	11	184	31	3	101	20	3	58	26	11	43	3	13	9	0	9	1	0	0	0	0	0	0	0	0	0	0	3.11	5	
1914.....	124	8	367	44	2	152	40	15	115	25	7	64	10	15	25	1	8	3	0	9	1	0	0	0	0	0	0	0	0	0	0	3.22	16	
1915.....	131	11	380	11	13	50	26	4	84	28	1	81	42	5	106	15	10	35	2	15	6	1	3	2	0	0	0	0	0	0	0	4.89	27	
Average.....	115.8	338	24.6	97	24.9	76	19.4	53	21.8	48	8.3	18	7.5	14	1.5	2	3.5	6	1.3	2	0	0	0	0	0	0	0	0	0	0	0	3.03	12	
64, tree No. 23-93-6, Valencia strain:																																		
Orchard grade—																																		
1912.....	61	15	121	0	0	0	2	7	80	11	15	33	10	6	26	3	5	7	0	9	1	0	0	0	0	0	0	0	0	0	0	1.67	...	
1913.....	77	7	254	26	6	107	24	14	80	14	4	33	10	6	26	3	5	7	0	9	1	0	0	0	0	0	0	0	0	0	0	4.67	...	
1914.....	97	7	290	48	2	160	32	1	88	12	14	32	3	14	9	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3.67	...	
1915.....	97	15	306	20	11	78	28	13	94	24	2	70	21	8	57	2	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.67	...
Average.....	83.7	243	23.8	86	22.1	67	12.8	35	10.2	26	3.9	9	6.2	12	1.0	2	2.5	4	1.3	2	0	0	0	0	0	0	0	0	0	0	0	3.42	...	

[illegible]

^a No count was made to determine the seed content of the fruits in this group.

Standard grade—	23 8	59	1 2	4	3 9	11	5 7	15	4 13	12	2 0	4	6 1	12	0 0	0	0 8	1	0 0	0	0 0	0	2 67
	16 9	69	12 15	55	2 12	10	0 6	2	0 4	1	0 4	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0 5 67	
	1913	7 9	20	1 3	4	0 0	9	0 6	1	0 14	2	1 8	3	0 0	0	0 0	0 0	0	0 10	1	0 0	0 6 00	
	1914	32 3	90	6 8	26	8 6	28	9 4	26	4 7	11	3 2	7	0 8	1	0 0	0	0 0	0	0 0	0	4 67	
	1915																						
Average.....	20.0	62	5.4	22	4.4	15	3.9	11	2.6	7	1.7	4	1.6	3	0 0	0	0.3	0.5	0	0	0	4.75	
Cull fruits—	6 0	15																				2 33	
	2 0	29																				4 67	
	1913	0 8	4																			6 67	
	1914	1 10	9																			5 67	
	1915																						
Average.....	2.5	14																				3 34	
Total crop—	113 5	288	4 4	16	18 2	56	16 13	46	32 13	83	15 14	34	16 9	33	1 2	2	1 12	3	0 0	0	0 0	0 2 11	
	116 1	424	43 15	180	39 3	120	17 9	52	10 15	28	2 7	6	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0 4 44	
	1913	74 4	194	12 10	40	22 14	60	26 14	66	8 2	18	2 10	5	0 0	0	0 0	0 10	1	0 0	0	0 0	0 3 00	
	1914	122 0	359	16 2	61	27 8	88	29 9	84	33 6	91	8 5	19	3 0	6	0 8	1	0 0	0	0 0	0	0 4 89	
	1915																						
Average.....	106.4	316	19.2	74	26.9	83	22.7	62	21.8	55	7.3	16	4.9	10	0.4	1	0.6	1	0	0	0	3.61	
76, tree No. 27-83-13, Cornu- gated strain: Ordinary grade—	31 6	80	0 12	3	4 4	14	4 6	13	8 13	22	3 13	9	5 10	12	1 8	3	2 4	4	0 0	0	0 0	0 1 00	
	27 4	80	4 3	16	7 8	24	5 7	15	7 16	19	2 12	6	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0 3 00	
	1912	27 2	71	3 7	11	7 6	21	9 11	24	5 11	13	0 7	1	0 8	1	0 0	0	0 0	0	0 0	0	0 5 33	
	1913	15 7	32	0 0	0	0 0	0	0 11	2	2 0	5	2 4	5	6 1	12	3 3	6	1 4	2	0 0	0	0 6 33	
	1915																						
Average.....	25.3	66	2.1	8	4.8	15	5.0	14	6.0	15	2.3	5	3.0	6	1.2	2	0.9	2	0	0	0	3.92	
Standard grade—	115 9	268																				0	
	107 5	407																				3 67	
	1912	107 3	295																			1 33	
	1913	84 3	215	11 12	43	22 6	68	15 10	42	21 2	9 8	22	3 13	8	0 0	0	0 0	0	0 0	0	0	3 67	
	1915	10 12	23	0 0	0	0 0	0	0 11	2	1 2	3	1 1	2	3 9	7	1 1	2	0 10	1	0 0	0		
Average.....	79.5	233																				2.17	
Cull fruits—	0 0	0																				0	
	3 0	31																				0 33	
	1912	1 3	5																			1 33	
	1913	0 0	0																			(a)	
	1915																					.55	
Average.....	1.0	9																					

^a No count was made to determine the seed content of the fruits in this group.

Total crop—	122 4	270	4 5	16	6 3	19	11 4	30	22 2	53	14 2	31	32 7	63	3 15	7	16 2	27	5 8	8	0 0	0	.44	5
1912.....	94 8	331	29 15	132	14 2	46	13 2	37	13 13	35	6 0	13	7 8	15	1 1	2	2 6	4	0 11	1	0 0	0	1.78	7
1913.....	100 13	290	37 13	129	25 15	72	17 4	42	12 0	26	5 0	10	9 9	1	0 0	0	0 10	1	0 0	0	0 0	0	2.22	21
1914.....	86 5	227	7 7	29	5 10	18	13 12	40	26 11	66	15 1	34	9 5	19	5 8	10	1 4	2	0 11	1	0 0	0	3.22	11
1915.....	101 0	280	19 9	77	13 0	39	13 8	37	18 7	45	10 1	22	12 5	25	2 6	5	5 1	9	1 7	3	0	0	1.92	11
Average.....																								
83, tree No. 23-89-7, Valencia strain—																								
Orchard grade—																								
1912.....	47 8	93	0 8	2	0 0	0	3 0	8	6 0	14	8 7	18	13 2	25	3 9	6	7 5	12	5 9	8	0 0	0	.33	...
1913.....	84 8	263	19 6	81	26 13	83	19 10	54	16 11	41	1 6	3	0 0	0	0 10	1	0 0	0	0 0	0	0 0	0	2.33	...
1914.....	85 9	236	22 10	73	33 14	94	20 6	50	7 2	16	1 9	3	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	2.00	...
1915.....	68 5	178	0 10	3	8 4	26	9 11	28	28 8	74	13 0	30	6 10	14	1 10	3	0 0	0	0 0	0	0 0	0	7.33	...
Average.....	71.5	193	10.8	40	17.2	51	13.2	35	14.6	36	6.1	14	4.9	10	1.5	3	1.8	3	1.4	2	0	0	2.99	...
Standard grade—																								
1912.....	28 9	58	0 14	3	1 12	5	1 2	3	4 14	11	4 2	8	9 3	17	1 10	3	5 0	8	0 0	0	0 0	0	.67	...
1913.....	21 4	93	13 12	70	6 0	19	1 8	4	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	3.33	...
1914.....	13 5	41	6 2	22	2 12	9	1 2	3	1 12	4	1 1	2	0 8	1	0 0	0	0 0	0	0 0	0	0 0	0	2.67	...
1915.....	31 6	95	1 2	5	13 0	43	9 6	27	4 13	13	2 1	5	1 0	2	0 0	0	0 0	0	0 0	0	0 0	0	6.00	...
Average.....	23.6	72	5.5	25	5.9	19	3.3	9	2.9	7	1.8	4	2.7	5	0.4	1	1.3	2	0	0	0	0	3.17	...
Cull fruits—																								
1912.....	10 0	18																					1.33	...
1913.....	7 6	101																					3.00	...
1914.....	1 5	6																					4.33	...
1915.....	2 10	12																					5.00	...
Average.....	5.3	34																					3.42	...
Total crop—																								
1912.....	86 1	169	1 6	5	1 12	5	4 2	11	10 14	25	12 9	26	22 5	42	5 3	9	12 5	20	5 9	8	0 0	0	.78	0
1913.....	113 2	457	33 2	151	32 13	102	21 2	58	16 11	41	1 6	3	0 0	0	0 10	1	0 0	0	0 0	0	0 0	0	2.89	1
1914.....	100 3	283	38 12	95	36 10	103	21 8	53	8 14	20	2 10	5	0 8	1	0 0	0	0 0	0	0 0	0	0 0	0	3.00	8
1915.....	102 5	285	1 12	8	21 4	69	19 1	55	33 5	87	15 1	35	7 10	16	1 10	3	0 0	0	0 0	0	0 0	0	6.11	6
Average.....	100.4	299	16.3	65	23.1	70	16.5	44	17.4	43	7.9	17	7.6	15	1.9	3	3.1	5	1.4	2	0	0	3.20	4
84, tree No. 23-75-23, Valencia strain—																								
Orchard grade—																								
1912.....	44 14	91	0 4	1	1 6	4	1 2	3	7 4	17	9 4	20	9 4	19	2 2	4	10 2	17	4 2	6	0 0	0	1.00	...
1913.....	98 14	350	47 11	193	37 2	118	8 11	25	4 8	12	0 14	2	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	4.00	...
1914.....	53 1	145	17 2	56	13 2	37	10 0	25	10 10	24	0 7	1	1 2	2	0 0	0	0 0	0	0 0	0	0 0	0	3.67	...
1915.....	76 5	212	5 7	20	10 13	34	16 2	47	29 2	77	11 9	27	3 4	7	0 0	0	0 0	0	0 0	0	0 0	0	5.00	...
Average.....	68.3	200	17.6	68	15.6	48	9.0	25	12.9	33	5.5	13	3.4	7	0.5	1	2.5	4	1.0	2	0	0	3.42	...

Total crop—	37 5	69	0 8	2	0 5	1	0 12	2	4 13	11	2 15	6	10 2	19	1 3	2	5 12	9	7 7	11	0 0	0	1 33	0
	117 1	463	48 1	210	37 3	123	15 6	45	11 1	239	1 12	4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	3 33	0
	101 14	288	24 8	83	26 3	73	29 5	73	14 7	33	4 13	10	1 9	3 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	2 56	4	
	131 2	380	13 5	47	29 2	97	29 2	86	44 6	113	11 3	25	1 14	4 0	0 9	1	0 0	0 0	0 0	0 0	0 0	4 78	7	
	96.8	300	21.6	86	23.3	74	18.6	52	18.7	47	5.2	11	3.4	7	0.4	1	1.4	2	1.9	3	0	3.00	3	
Average.....																								
88, tree No. 23-86-3, Valencia strain: Orchard grade—	44 4	84	0 0	0	0 5	1	1 2	3	3 13	9	9 15	21	10 5	20	4 1	7	11 2	18	3 9	5	0 0	0	1 33	...
	73 14	278	45 1	190	19 6	63	4 15	14	2 12	7	0 8	1	1 4	3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 33	...
	64 13	157	6 13	21	19 9	31	17 3	41	15 14	34	3 2	6	2 4	4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	5.00	...
	88 0	253	3 13	15	9 8	33	27 10	85	34 10	92	7 13	18	4 1	9	0 9	1	0 0	0 0	0 0	0 0	0 0	0 0	8.00	...
	67.7	193	13.9	57	12.3	37	12.7	36	14.3	36	5.3	12	4.5	9	1.2	2	2.8	5	0.9	1	0	0	3.92	...
Standard grade—	25 4	49	0 0	0	0 0	0	1 3	3	4 7	10	5 7	11	8 13	16	1 10	3	3 12	6	0 0	0	0 0	0	.67	...
	20 14	101	18 0	92	2 1	7	0 6	1	0 7	1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	.67	...
	7 13	21	1 2	4	2 2	6	0 6	1	3 5	8	0 13	1	0 7	1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	4.67	...	
	39 6	124	11 4	43	14 5	44	10 1	28	1 15	5	0 13	2	1 0	2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	4.33	...	
	23.3	74	7.6	35	4.6	14	3.0	8	2.5	6	1.7	4	2.6	5	0.4	1	0.9	2	0	0	0	2.59	...	
Cull fruits—	10 0	22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	...
	3 13	62	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4.33	...
	0 8	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4.50	...
	1 12	8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3.67	...
	4.0	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3.13	...
Total crop—	79 8	155	0 0	0	0 5	1	2 5	6	8 4	19	15 6	32	19 2	36	5 11	10	14 14	24	3 9	5	0 0	0	.56	11
	97 9	441	63 1	282	21 7	70	5 5	15	3 3	8	0 8	1	1 4	3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	2.11	9	
	73 2	180	7 15	25	21 11	57	17 9	42	19 3	42	3 9	7	2 11	5	0 0	0 0	0 0	0 0	0 0	0 0	0 0	4.63	15	
	129 2	385	15 1	58	23 13	77	37 11	113	36 9	97	8 10	20	5 1	11	0 9	1	0 0	0 0	0 0	0 0	0 0	5.33	13	
	94.8	290	21.5	91	16.8	51	15.7	44	16.8	42	7.0	15	7.0	14	1.6	3	3.7	6	0.9	1	0	3.16	12	
89, tree No. 23-91-6, Coarse strain: Orchard grade—	6 3	11	0 0	0	0 0	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.50	...
	104 12	398	44 3	203	31 12	113	8 15	28	14 1	40	2 17	7	3 2	7	0 0	0 0	0 0	0 0	0 0	0 0	0 0	2.33	...	
	12 5	40	4 10	18	5 0	15	2 4	6	0 7	1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	5.00	...	
	16 14	33	0 0	0	0 5	1	0 6	1	1 10	4	2 5	5	5 0	10	4 12	8	1 13	3	0 11	1	0 0	0	5.67	...
	35.0	121	12.2	55	9.3	32	3.1	9	4.1	12	1.3	3	2.6	5	1.3	2	1.1	2	0.3	0.5	0	0	3.38	...

Total crop	78	0	193	2	13	10	6	5	20	11	5	32	18	0	45	13	7	30	17	0	35	1	11	3	2	3	4	1	4	2	0	0	0	1.00	4		
	96	1	353	26	7	113	34	1	112	14	11	43	15	11	42	2	2	5	0	8	1	0	0	0	0	0	0	0	0	0	0	0	3.22	6			
	72	7	207	7	6	41	27	7	72	17	0	43	14	9	33	3	12	9	0	8	1	0	9	1	0	0	0	0	0	0	0	0	2.56	5			
	92	2	243	3	2	18	8	0	26	10	4	30	36	3	92	20	14	48	8	4	17	4	12	9	0	0	0	0	0	0	0	0	2.67	10			
	Average	84.6	249	9.9	46	19.0	58	13.3	37	21.1	53	10.1	23	6.6	14	6.6	14	1.8	3	0.5	1	0.3	0.5	0	0	2.36	0	0	2.36	6	0	0	2.36	6			
93, tree No. 23-88-5, Rough strain:																																					
Orchard grade—																																					
1912																																					
1913																																					
1914																																					
1915																																					
Average																																					
Standard grade—																																					
1912																																					
1913																																					
1914																																					
1915																																					
Average																																					
Cullfruits—																																					
1912																																					
1913																																					
1914																																					
1915																																					
Average																																					
Total crop	102	12	249																														1.11	21			
	59	13	196																														1.38	31			
	112	14	415	81	2	318	23	3	71	5	4	14	1	3	3	0	15	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.67	89			
	54	11	136	0	13	4	4	7	14	9	3	26	13	3	33	15	11	34	7	4	15	2	14	5	1	2	2	0	0	0	0	0	3.00	44			
	Average	82.5	249																														1.97	46			
94, tree No. 23-89-5, Unproductive strain:																																					
Orchard grade—																																					
1912																																					
1913																																					
1914																																					
1915																																					
Average																																					

a Result of the examination of three Rough-strain fruits.

b No count was made to determine the seed content of the fruits in this group.

[illegible]

^a No count was made to determine the seed content of the fruits in this group.

[illegible]

a. No count was made to determine the seed content of the fruits in this group.

In each succeeding year of these investigations, the workers became familiar with an increasing number of variable forms of fruits and recorded their occurrence as they were observed. This accounts for the general increase from year to year in the number of such fruits recorded. Because of this increase in the number of variable forms observed, the figures given here as the average annual production of such fruits are too low, especially for those trees which have borne a large number of such variable fruits. When securing performance records, late-bloom fruit and split fruit have been recorded, but such fruits have not been included with the variable fruits.

In expressing the average of weights in Table I, it was found impracticable to retain more than one decimal place. The more exact expression of ounces as a fractional part of a pound extends to four decimal places, but only one place has been retained. In expressing the averages for the number of fruits occurring in different groups, no decimal has been retained except when the average number is less than unity. Hence, it will be found that the totals of averages sometimes will vary slightly from the average of the totals of the corresponding number.

In recording the tree-performance data the fruits of the Cull grade are not assorted into sizes, and on this account the total figures for the weights and numbers of fruits of the various sizes represent only the commercial crops of the trees.

In determining the average number of seeds per fruit on the different trees counts are made when possible from a small, a medium, and a large fruit in each of the three grades. In this way a record is usually secured of the actual number of seeds in 9 fruits from each tree, and it is thought that this system gives a fairly accurate indication of the relative seediness of the fruits of the different trees. To determine the annual average number of seeds per fruit, the total number of seeds found is divided by the total number of fruits examined during the entire period. In the case of trees from which less than 9 fruits have been examined during any season the average obtained in this way gives equal weight to each fruit and is fairer and more accurate than to average the yearly averages.

In counting the variable fruits occurring on individual trees, the strain of each tree is considered the standard for that tree, and all deviations from it are considered as variable fruits. For example, on a tree of the Valencia strain all fruits other than those of the Valencia strain are considered to be variable for that tree, while on a tree of the Corrugated strain all fruits other than those of the Corrugated strain are counted as variable. With the trees of the Sporting strain, however, the fruit of the Valencia strain is considered to be normal, and all variable fruits are counted as off type for those trees. The

relatively large number of variable fruits recorded on a few of the Productive trees of the Valencia strain, such as those listed in ranks 1, 2, 6, 7, 10, etc., are almost entirely composed of those described briefly under the heading "Minor variations of fruits." Occasionally on one of these trees a small branch has been found bearing a few fruits of one of the major strains, but usually the variable fruits found on Productive trees of the Valencia strain are not of a character to lessen the commercial value of the crop.

The working out of methods of interpreting these individual-tree performance records and of applying the knowledge gained from their study is essential. It is a simple matter to choose between healthy trees of the same age grown under identical cultural conditions when they have such widely different records as those presented for the trees listed in ranks 2 and 88 in Table I. But to make a choice between similarly grown trees with such performance records as those listed in ranks 2 and 3 is quite a different problem. The average annual production of these two trees for the four years was practically identical, 178.2 pounds and 178 pounds, but the actual yields each year varied considerably. The tree listed in rank 2 bore a gradually increasing amount of fruit during the 4-year period, while the one recorded in rank 3 bore heavily the first year, produced a lighter crop the next season, and an increasingly heavy one each succeeding year. The large number of variable fruits occurring on the tree in rank 2 is partly explained by the presence in the tree of a limb which produces fruits of the Ribbed strain. Both these trees appear to be of relatively high commercial value as crop producers and as sources of desirable bud wood for use in nursery propagation or for top-working trees of undesirable strains, and before any intelligent choice could be made between the two it would be necessary to know their performance records for one or two years more.

The annual-production records by fruit sizes for these two trees for the year 1912 when compared with the records for the succeeding years show a great variation in the proportion of fruit of the various commercial sizes in the crops of the individual trees. This variation was not due to the quantity of fruit on the individual trees, for it is equally marked on both these trees, although there is a considerable difference in the weight and number of fruit borne by them that season. The general production of oranges of large sizes during some years is well recognized by citrus growers and is thought to be the result of seasonal climatic conditions. An inspection of the annual performance records of the other trees presented herewith lends weight to this theory, for it will be found that, without exception, all the trees produced a relatively small number of small-sized fruit during the season of 1912 in comparison with the season of 1913, irrespective of whether or not the total yield during that season was larger or smaller

than in 1913. The 1915 records of many of the trees show this same tendency in a lesser degree, indicated by a relative decrease in production of fruits of the very smallest sizes, even where, as was the case with the tree listed in rank 3, the total crop for that year was larger than during the previous year.

Table II shows the percentage of fruit of the first or Orchard grade produced by each tree and the proportion of variable fruits recorded from each during the 4-year period. These percentages are calculated from the records of actual yields shown in Table I, and they are an aid in interpreting those data and in judging the relative commercial value of the individual trees both from the standpoint of crop production and as sources of desirable bud wood.

TABLE II.—*Performance records of 105 Valencia orange trees, showing the percentages of fruits of Orchard grade and of variable fruits borne by each tree, 1912 to 1915, inclusive.*

Rank in Table I.	Percentage of fruits.		Rank in Table I.	Percentage of fruits.		Rank in Table I.	Percentage of fruits.	
	Orchard grade (by weight).	Variable (by num- ber).		Orchard grade (by weight).	Variable (by num- ber).		Orchard grade (by weight).	Variable (by num- ber).
1.....	78.6	3.5	36.....	62.0	2.9	71.....	70.6	0.6
2.....	67.7	7.3	37.....	59.0	2.1	72.....	72.1	2.7
3.....	67.9	.5	38.....	72.0	.7	73.....	77.6	.2
4.....	68.9	.5	39.....	81.3	.5	74.....	62.0	6.1
5.....	74.4	1.3	40.....	29.2	42.8	75.....	78.8	3.8
6.....	68.4	9.2	41.....	17.3	25.0	76.....	23.9	38.0
7.....	77.8	5.3	42.....	62.8	12.1	77.....	18.8	38.1
8.....	76.8	.6	43.....	72.7	.3	78.....	14.8	26.4
9.....	80.2	.4	44.....	46.1	26.1	79.....	24.4	37.9
10.....	73.4	5.7	45.....	50.7	13.5	80.....	52.5	7.5
11.....	71.9	4.8	46.....	67.2	2.6	81.....	73.7	2.5
12.....	64.3	6.3	47.....	22.9	33.5	82.....	79.8	3.9
13.....	77.6	.8	48.....	68.1	4.4	83.....	71.2	1.3
14.....	75.6	.9	49.....	60.5	4.8	84.....	68.1	6.5
15.....	75.2	.6	50.....	73.8	.8	85.....	72.4	1.1
16.....	69.5	.9	51.....	79.2	1.1	86.....	65.6	7.3
17.....	73.2	1.7	52.....	62.0	6.2	87.....	76.2	1.0
18.....	72.3	1.6	53.....	65.3	4.4	88.....	71.4	4.1
19.....	76.5	1.5	54.....	72.1	1.6	89.....	37.2	5.8
20.....	73.5	1.7	55.....	71.4	5.1	90.....	52.2	4.9
21.....	68.3	5.8	56.....	81.3	2.3	91.....	64.9	6.3
22.....	59.3	6.5	57.....	67.7	2.4	92.....	67.4	2.4
23.....	72.8	.7	58.....	71.9	5.2	93.....	12.2	18.5
24.....	70.8	4.0	59.....	73.4	5.3	94.....	64.5	5.6
25.....	70.8	7.3	60.....	57.7	7.2	95.....	55.1	7.8
26.....	65.5	4.2	61.....	59.3	4.2	96.....	45.6	13.0
27.....	63.3	9.1	62.....	65.8	.6	97.....	59.8	6.3
28.....	72.6	8.1	63.....	70.2	3.6	98.....	50.6	30.8
29.....	63.8	5.0	64.....	72.3	.5	99.....	57.4	13.1
30.....	61.0	6.4	65.....	67.2	7.9	100.....	60.6	5.2
31.....	73.3	.8	66.....	76.5	2.4	101.....	57.6	6.7
32.....	75.3	1.0	67.....	39.5	67.8	102.....	62.0	8.1
33.....	77.5	2.0	68.....	82.6	3	103.....	72.0	12.1
34.....	70.2	4.5	69.....	67.7	7.2	104.....	19.3	40.9
35.....	79.8	1.2	70.....	77.4	6.6	105.....	.3	68.8

Table III shows in its first section (sec. A) the performance record of an orange tree of the Valencia strain for the season of 1915, as entered on the annual record form, and also the 4-year period performance record of the same tree. The detailed annual record is copied from the field notebook and shows the data therein recorded for each individual tree. The summary of this annual record is copied on the period form, as shown by the second

part of section A of the table. In order to economize space in publication, the detailed record form as shown here has been rearranged from that actually used in the investigations, but the summary records presented are in substantially the same form in which they were recorded. By means of this summary record form it is possible not only to compare the total crops for successive seasons, but also to study the relative amount of fruit in the different grades and sizes.

Sections B and C of Table III, showing both annual and 4-year period performance records for individual trees of the Corrugated and Barren strains, are given for comparison with section A of the same table. Considered as a series, these tabular statements show some of the great variations between trees of different strains, especially with respect to the amount of their total crops and the quality of the crops as indicated by the relative proportions of fruit of the different grades. These variations illustrate the relative value of these strains and are typical of the differences in production that exist in other strains of this variety. Considered as a record of individual trees, this table shows in detail the character of successive crops and their variations in quality and quantity.

TABLE III.—*Performance record of individual Valencia orange trees of different strains, showing the weight and number of the fruits of each grade and size and the variable fruits produced, detailed for the season of 1915, and also summarized for four seasons, 1912 to 1915, inclusive.*

[This summarized record illustrates the method of assembling the data of successive seasons for careful comparison and study. In practice, the variable fruits produced by the tree each season and the record of the number of seeds found in representative fruits are listed on the back of the forms. The weights are given in pounds and ounces, except that the fractional averages are expressed decimally in pounds.]

SECTION A.—TREE No. 23-85-10, VALENCIA STRAIN, LISTED IN RANK 32 IN TABLES I AND II.

DETAILED RECORD FOR THE SEASON OF 1915.¹

Sizes of fruits.	Orchard grade.		Standard grade.		Total.		Cull fruits.		Grand total.	
	Weight.	Num-ber.	Weight.	Num-ber.	Weight.	Num-ber.	Weight.	Num-ber.	Weight.	Num-ber.
	<i>Lbs. oz.</i>		<i>Lbs. oz.</i>		<i>Lbs. oz.</i>		<i>Lbs. oz.</i>		<i>Lbs. oz.</i>	
288 and smaller.....	1 10	6	10 10	41	12 4	47	.....	.....	.....	.....
250.....	5 14	20	24 0	75	29 14	95	.....	.....	.....	.....
216.....	18 12	57	13 2	37	31 14	94	.....	.....	.....	.....
200.....	58 5	135	13 1	33	71 6	188	.....	.....	.....	.....
176.....	25 1	59	2 10	6	27 11	65	.....	.....	.....	.....
150.....	9 9	21	1 8	3	11 1	24	.....	.....	.....	.....
126.....	0 8	1	0 0	0	0 8	1	.....	.....	.....	.....
112.....	0 0	0	0 0	0	0 0	0	.....	.....	.....	.....
96.....	0 0	0	0 0	0	0 0	0	.....	.....	.....	.....
80 and larger.....	0 0	0	0 0	0	0 0	0	.....	.....	.....	.....
Total.....	119 11	319	64 15	195	184 10	514	0 12	4	185 6	518
Seeds found:										
Small fruits.....		1	.....	3	.....	4	.....	3	.....	7
Medium fruits.....		4	.....	7	.....	11	.....	1	.....	12
Large fruits.....		5	.....	7	.....	12	.....	1	.....	13

¹ NOTES.—Total crop, 4½ boxes. Variable fruits: Australian, 1; Ridged, 2; Creased, 1; Raised section, 3; Abnormal section, 1; Split side, 1; Off bloom, 2.

TABLE III.—*Performance record of individual Valencia orange trees of different strains, showing the weight and number of the fruits of each grade and size and the variable fruits produced, detailed for the season of 1915, and also summarized for four seasons, 1912 to 1915, inclusive—Continued.*

SECTION A.—TREE No. 23-85-10, VALENCIA STRAIN, LISTED IN RANK 32 IN TABLES I AND II—Continued.

SUMMARIZED RECORD FOR FOUR SEASONS.

Grades and sizes.	1912	1913	1914	1915	Total.	Average.
Weight of fruits:	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	
Orchard grade.....	91 5	96 9	111 4	119 11	418 13	104.7
Standard grade.....	19 1	19 1	16 11	64 15	119 12	29.9
Culls.....	7 0	7 9	2 8	0 12	17 13	4.5
Grand total.....	117 6	123 3	130 7	185 6	556 6	139.1
Sizes—						
288 and smaller.....	5 4	36 1	36 1	12 4	89 10	22.4
250.....	8 3	22 1	44 10	29 14	104 12	26.2
216.....	8 3	14 12	26 15	31 14	81 12	20.4
200.....	30 9	21 9	17 5	71 6	140 13	35.2
176.....	20 14	9 5	3 0	27 11	60 14	15.2
150.....	25 14	7 11	0 0	11 1	44 10	11.1
126.....	4 7	2 15	0 0	0 8	7 14	2.0
112.....	4 4	1 4	0 0	0 0	5 8	1.4
96.....	2 0	0 0	0 0	0 0	2 0	.5
80 and larger.....	0 12	0 0	0 0	0 0	0 12	.2
Total.....	110 6	115 10	127 15	184 10	538 9	134.6
Number of fruits:						
Orchard grade.....	204	295	302	319	1,120	280.0
Standard grade.....	46	77	53	195	371	92.8
Culls.....	17	78	13	4	112	28.0
Grand total.....	267	450	368	518	1,603	400.8
Sizes—						
288 and smaller.....	17	161	119	47	344	86.0
250.....	24	73	124	95	316	79.0
216.....	22	42	67	94	225	56.25
200.....	73	54	39	188	354	88.5
176.....	45	20	6	65	136	34.0
150.....	50	15	0	24	89	22.25
126.....	8	5	0	1	14	3.5
112.....	7	2	0	0	9	2.25
96.....	3	0	0	0	3	.75
80 and larger.....	1	0	0	0	1	.25
Total.....	250	372	355	514	1,491	372.75

SECTION B.—TREE No. 23-85-7, CORRUGATED STRAIN, LISTED IN RANK 47 IN TABLES I AND II.

[In 1912 and 1913 the fruits of this tree were not assorted according to size.]

DETAILED RECORD FOR THE SEASON OF 1915.¹

Sizes of fruits.	Orchard grade.		Standard grade.		Total.		Cull fruits.		Grand total.	
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.
	<i>Lbs. oz.</i>		<i>Lbs. oz.</i>		<i>Lbs. oz.</i>		<i>Lbs. oz.</i>		<i>Lbs. oz.</i>	
288 and smaller.....	0 0	0	4 1	15	4 1	15				
250.....	2 0	7	8 10	26	10 10	33				
216.....	2 4	7	10 12	29	13 0	36				
200.....	15 3	39	14 6	36	29 9	75				
176.....	8 13	20	18 2	40	26 15	60				
150.....	8 14	18	4 15	10	13 13	28				
126.....	6 6	12	2 5	4	8 11	16				
112.....	0 0	0	0 11	1	0 11	1				
96.....	0 0	0	0 0	0	0 0	0				
80 and larger.....	0 0	0	0 0	0	0 0	0				
Total.....	43 8	103	63 14	161	107 6	264	0 10	3	108 0	267
Seeds found:										
Small fruits.....		7		2		9		0		9
Medium fruits.....		4		2		6		1		7
Large fruits.....		8		4		12		2		14

¹ NOTES.—Total crop, 2½ boxes. Corrugated fruits tend to be long and pear shaped, greenish yellow in color. Sports: Wrinkled, 1; Corrugated, 132; Ridged, 7; Creased, 4; Sunken section, 1; Yellow section, 1; Long, 2; Green section, 1; Ridged and Creased, 3; Granular, 11; Half Corrugated, Half Standard, 1.

TABLE III.—Performance record of individual Valencia orange trees of different strains, showing the weight and number of the fruits of each grade and size and the variable fruits produced, detailed for the season of 1915, and also summarized for four seasons, 1912 to 1915, inclusive—Continued.

SECTION B.—TREE No. 23-85-7, CORRUGATED STRAIN, LISTED IN RANK 47 IN TABLES I AND II—Continued.

SUMMARIZED RECORD FOR FOUR SEASONS.

Grades and sizes.	1912	1913	1914	1915	Total.	Average.
Weight of fruits:	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	<i>Lbs. oz.</i>	
Orchard grade.....	18 1	31 1	20 14	43 8	113 8	28.4
Standard grade.....	119 9	76 2	114 4	63 14	373 13	93.5
Culls.....	2 13	3 4	2 7	0 10	9 2	2.3
Grand total.....	140 7	110 7	137 9	108 0	496 7	124.1
Sizes—						
288 and smaller.....			56 11	4 1		
250.....			40 11	10 10		
216.....			15 4	13 0		
200.....			16 9	29 9		
176.....			3 11	26 15		
150.....			2 4	13 13		
126.....			0 0	8 11		
112.....			0 0	0 11		
96.....			0 0	0 0		
80 and larger.....			0 0	0 0		
Total.....	137 10	107 3	135 2	107 6	477 5	121.8
Number of fruits:						
Orchard grade.....	39	89	61	103	292	73.0
Standard grade.....	266	216	339	161	982	245.5
Culls.....	9	36	12	3	60	15.0
Grand total.....	314	341	412	267	1,334	333.5
Sizes—						
288 and smaller.....			198	15		
250.....			115	33		
216.....			38	36		
200.....			38	75		
176.....			7	60		
150.....			4	28		
126.....			0	16		
112.....			0	1		
96.....			0	0		
80 and larger.....			0	0		
Total.....	305	305	400	264	1,274	318.5

SECTION C.—TREE No. 37-58-23, BARREN STRAIN, LISTED IN RANK 105 IN TABLES I AND II.

DETAILED RECORD FOR THE SEASON OF 1915.¹

Sizes of fruits.	Orchard grade.		Standard grade.		Total.		Cull fruits.		Grand total.	
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.
	<i>Lbs. oz.</i>		<i>Lbs. oz.</i>		<i>Lbs. oz.</i>		<i>Lbs. oz.</i>		<i>Lbs. oz.</i>	
288 and smaller.....	0 0	0	1 0	4	1 0	4				
250.....	0 0	0	0 0	0	0 0	0				
216.....	0 0	0	0 0	0	0 0	0				
200.....	0 0	0	0 6	1	0 6	1				
176.....	0 0	0	0 0	0	0 0	0				
150.....	0 0	0	0 8	1	0 8	1				
126.....	0 0	0	0 0	0	0 0	0				
112.....	0 0	0	0 0	0	0 0	0				
96.....	0 0	0	0 0	0	0 0	0				
80 and larger.....	0 0	0	0 0	0	0 0	0				
Total.....			1 14	6	1 14	6	0 15	4	2 13	10
Seeds found:										
Small fruits.....	(2)			2		2		1		3
Medium fruits.....	(2)			2		2		2		4
Large fruits.....	(2)			5		5		3		8

¹ No sports.

² Seeds in fruits of the Orchard grade were not counted.

TABLE III.—*Performance record of individual Valencia orange trees of different strains, showing the weight and number of the fruits of each grade and size and the variable fruits produced, detailed for the season of 1915 and also summarized for four seasons, 1912 to 1915, inclusive—Continued.*

SECTION C.—TREE No. 37-58-26, BARREN STRAIN, LISTED IN RANK 105 IN TABLES I AND II—Continued.

SUMMARIZED RECORD FOR FOUR SEASONS.

Grades and sizes.	1912	1913	1914	1915	Total.	Average.
Weight of fruits:	Lbs. oz.	Lbs. oz.	Lbs. oz.	Lbs. oz.	Lbs. oz.	
Orchard grade.....	0 0	0 8	0 0	0 0	0 8	0.13
Standard grade.....	2 1	1 7	0 0	1 14	5 6	1.34
Culls.....	7 13	0 2	0 0	0 15	8 14	2.22
Grand total.....	9 14	2 1	0 0	2 13	14 12	3.69
Sizes—						
288 and smaller.....	0 9	1 7	0 0	1 0	3 0	.75
250.....	0 0	0 0	0 0	0 0	0 0	0
216.....	1 2	0 0	0 0	0 0	1 2	.28
200.....	0 0	0 8	0 0	0 6	0 14	.22
176.....	0 6	0 0	0 0	0 0	0 6	.09
150.....	0 0	0 0	0 0	0 8	0 8	.13
126.....	0 0	0 0	0 0	0 0	0 0	0
112.....	0 0	0 0	0 0	0 0	0 0	0
96.....	0 0	0 0	0 0	0 0	0 0	0
80 and larger.....	0 0	0 0	0 0	0 0	0 0	0
Total.....	2 1	1 15	0 0	1 14	5 14	1.47
Number of fruits:						
Orchard grade.....	0	1	0	0	1	.3
Standard grade.....	6	6	0	6	18	4.5
Culls.....	40	2	0	4	46	11.5
Grand total.....	46	9	0	10	65	16.3
Sizes—						
288 and smaller.....	2	6	0	4	12	3
250.....	0	0	0	0	0	0
216.....	3	0	0	0	3	.75
200.....	0	1	0	1	2	.5
176.....	1	0	0	0	1	.25
150.....	0	0	0	1	1	.25
126.....	0	0	0	0	0	0
112.....	0	0	0	0	0	0
96.....	0	0	0	0	0	0
80 and larger.....	0	0	0	0	0	0
Total.....	6	7	0	6	19	4.75

A comparison of the records of the trees listed in ranks 45, 51, and 54 of Tables I and II will bring out further the variations in production that may occur within a strain as that term is here employed. These three trees produced practically the same average yields for the 4-year period, but their crops for each year have varied considerably and in very different ratios.

The tree listed in rank 45 is representative of a small class which shows a gradual decrease in production each year. This is, of course, an undesirable condition, and in commercial practice such trees should be top-worked as soon as their production falls below the point of profitableness. The tree listed in rank 51 is representative of the most desirable group of any commercially valuable strain, namely, that one in which the crop production is gradually increased from year to year. The trees recorded in ranks 2, 5, 9, 16, 17, 21, 27, and 37

are also typical of this group, and many others in the list are classified with these, though they are not as representative as those mentioned. The tree listed in rank 54 is typical of the group commonly called alternate bearers or biennial bearers; that is, a season of normal or high

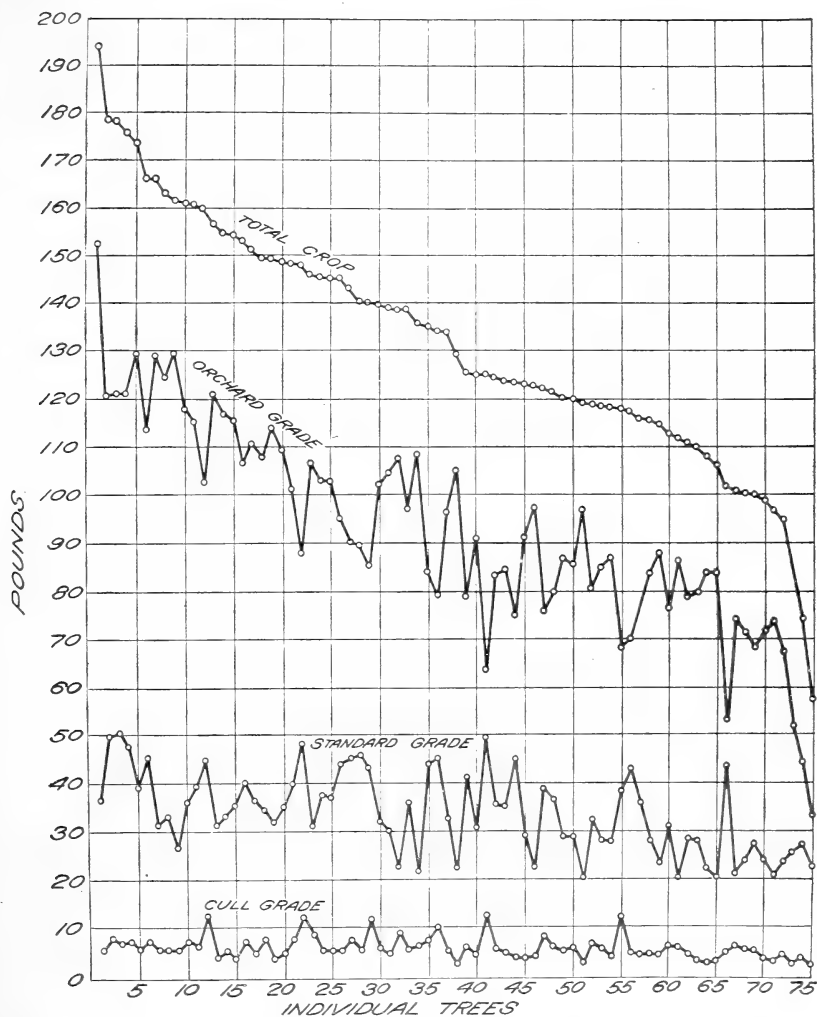


FIG. 1.—Diagram showing the average annual production of the 75 individual trees of the Valencia strain in the investigational performance-record plat for the 4-year period, 1912 to 1915, inclusive. The trees are here ranked in the order of their average total crop, expressed in pounds. The weight of the fruit of the three commercial grades is also shown for each tree.

production is followed by a small crop the next year, with the return of a normal crop the succeeding season. Usually these trees show a general increase in production during a period of years. This tree (rank 54) produced its small crops in the even years. The tree listed in rank 35 is also of this alternate-bearing character but bears its small

crops in the odd years. This group of trees may not be unprofitable to the grower, but they are not as desirable as those with a regular bearing habit.

The variation in the crop production of the individual trees of the Valencia strain in the performance-record plat is shown graphically in figure 1. The average annual crops of these 75 trees, which are planted in a single orchard block, vary from 57½ pounds to 193¼ pounds, but 64 of them, or 85 per cent of the total number, averaged between 100 and 160 pounds annually. This diagram also shows the variations in the amount of Orchard, Standard, and Cull grade fruit borne by trees producing practically the same total crops.

Section A of Table IV shows the average annual crop of all the Valencia orange trees occurring in the investigational performance-record plat in groups of strains and of select trees within some of these

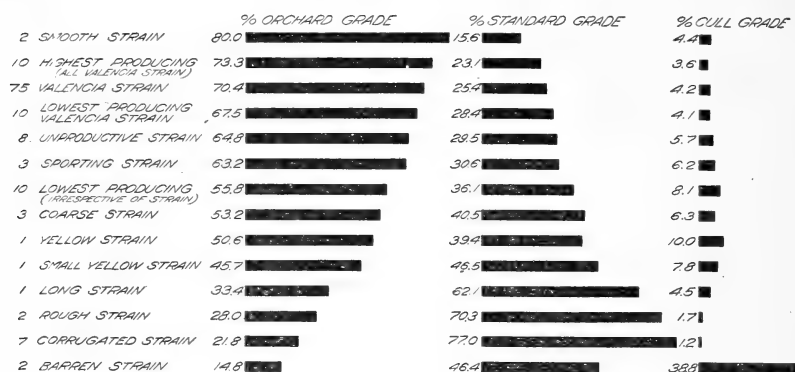


FIG. 2.—Diagram showing the percentages of fruit of the different commercial grades in the average annual production of the trees of the various strains found in the investigational performance-record plat of Valencia oranges for the 4-year period, 1912 to 1915, inclusive. The strains are listed in the order of their relative production by weight of fruit of the Orchard grade.

strains. The groups are arranged according to the weight of the average annual crop of each individual tree. The presence of Barren-strain trees will probably be a surprise to many Valencia growers. Trees of this strain and other low-producing strains when noticed in the orchards have usually been considered to be biennial bearers, in their off year. Records, such as those here reported, show that in some instances, at least, this theory is baseless. Here are shown the records of two trees of the Barren strain which have borne practically uniform crops for the past four years, with an average yearly crop of 6 pounds per tree, only 3.7 pounds being commercial fruit suitable for the market. It will be seen that nearly all the other sporting strains produced much less than is ordinarily expected from the average orchard tree and all of them averaged less than was produced by the trees of the Valencia strain.

Section B of Table IV shows the groups of trees of the different strains ranked according to the average annual crop of first, or Orchard, grade fruit produced. This change alters the relative position of several of the strains, but the Valencia strain is still at the head and the Barren strain at the foot of the list.

TABLE IV.—Average annual crop of groups of trees of the variable strains of the Valencia orange occurring in the investigational performance-record plat, showing production by commercial grades for the 4-year period, 1912 to 1915, inclusive.

Trees.		Average annual production per tree (pounds).			
Description.	Number.	Orchard grade.	Standard grade.	Cull fruits.	Total crop.
Section A.—Ranked according to their average total crops:					
Highest producing Valencia strain.....	10	125.9	39.6	6.1	171.6
Valencia strain.....	75	92.8	33.6	5.5	131.8
Sporting strain.....	3	80.7	39.0	7.9	127.6
Corrugated strain.....	7	24.7	87.4	1.4	113.5
Long strain.....	1	66.5	35.8	4.9	107.2
Coarse strain.....	3	53.1	40.4	6.2	99.7
Rough strain.....	2	27.6	69.2	1.7	98.5
Lowest producing Valencia strain.....	10	61.6	25.8	3.7	91.1
Small Yellow strain.....	1	36.1	36.8	6.2	79.1
Unproductive strain.....	8	50.0	22.8	4.4	77.2
Smooth strain.....	2	60.6	11.8	3.4	75.8
Yellow strain.....	1	36.5	28.4	7.2	72.1
Lowest producing trees.....	10	28.2	18.2	4.0	50.4
Barren strain.....	2	.9	2.8	2.3	6.0
General average.....		78.6	36.4	5.1	120
Section B.—Ranked according to the weight of fruit of Orchard grade produced:					
Highest producing Valencia strain.....	10	125.9	39.6	6.1	171.6
Valencia strain.....	75	92.8	33.6	5.5	131.8
Sporting strain.....	3	80.7	39.0	7.9	127.6
Long strain.....	1	66.5	35.8	4.9	107.2
Lowest producing Valencia strain.....	10	61.6	25.8	3.7	91.1
Smooth strain.....	2	60.6	11.8	3.4	75.8
Coarse strain.....	3	53.1	40.4	6.2	99.7
Unproductive strain.....	8	50.0	22.8	4.4	77.2
Yellow strain.....	1	36.5	28.4	7.2	72.1
Small Yellow strain.....	1	36.1	36.8	6.2	79.1
Lowest producing trees.....	10	28.2	18.2	4.0	50.4
Rough strain.....	2	27.6	69.2	1.7	98.5
Corrugated strain.....	7	24.7	87.4	1.4	113.5
Barren strain.....	2	.9	2.8	2.3	6.0
General average.....		78.6	36.4	5.1	120

It should be noted that the 10 highest producing trees of the Valencia strain are also the 10 highest producing trees in the plat, irrespective of strain. Table I shows that the highest producing tree of a strain other than the Valencia is twenty-eighth in rank.

Figure 2 shows graphically the percentages of Orchard, Standard, and Cull grade fruits in the average annual production of groups of trees of the various strains represented in the investigational performance-record plat. This diagram can best be interpreted by comparing it with Table IV, which shows the actual average crops of these groups of trees of the different strains. Although the trees of the Smooth strain head the list in figure 2, their actual average production was only 60.6 pounds of Orchard-grade fruit, with a total production of 75.8 pounds, so that in value to the grower they are

far below the trees of the Valencia strain. The trees of the Barren strain are again found at the foot of the list.

The percentages of the two grades making up the commercial crops in the various strains are shown graphically in figure 3. These data are based on the weight of the average production per tree for the 4-year period, and the strains are arranged in the order of the percentage of first, or Orchard, grade fruit produced. This diagram, like figure 2, can be interpreted rightly only by comparison with the data of actual yield as shown in Table IV.

Figure 4 shows the average weight of fruit of the different commercial sizes and grades which was produced during the 4-year period on the 10 highest producing trees in the investigational performance-record plat in comparison with the corresponding yields of the 10

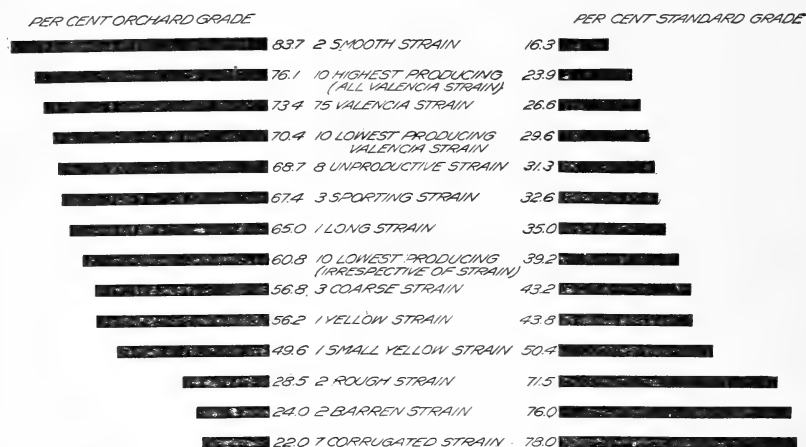


FIG. 3.—Diagram showing the percentages of Orchard and Standard grade fruit per tree in the average annual commercial crops of the trees of the various strains found in the investigational performance-record plat of Valencia oranges for the 4-year period, 1912 to 1915, inclusive. The strains are listed according to their proportion by weight of Orchard (or first) grade fruit.

lowest producing trees of the plat. This diagram illustrates graphically the fact that the heaviest bearing trees produce a larger proportion of the most desirable and valuable sizes of fruits than the lowest producing trees. The most productive trees also bear the largest proportion of fruit of first, or Orchard, grade, so that they are more profitable from the standpoint of quality and size of fruits, in addition to being high producers. On the other hand, the lowest producing trees bear a much larger proportion of extremely small fruits and fruits of the Standard (or second) grade.

Figure 5 is similar to figure 4, in that it shows the percentages of fruit of the different commercial sizes which were produced by the 10 highest and the 10 lowest yielding trees in the performance-record plat, but in this diagram the figures are based on the number

of fruits produced instead of on the weight of the fruits. This serves to emphasize the small-sized fruits and the Cull grades.

Figure 6, like figures 4 and 5, shows the average number of fruits produced by the 10 highest and 10 lowest yielding trees, but the yields of fruit of the different sizes are expressed as percentages of a packed box. The highest producing trees bore an annual average of 2.15 packed boxes per tree, as compared with a yield of 0.63 of a packed box from the lowest yielding trees. This difference indicates something of the value and desirability of growing only trees of the best strain in commercial orchards. These yields are very low, especially those from the best trees, but it should be remembered in this con-

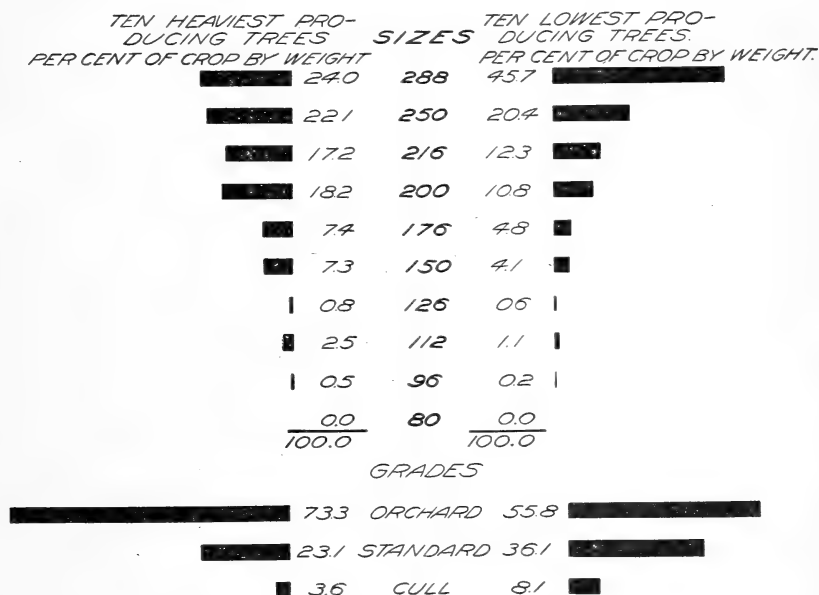


FIG. 4.—Diagram showing the variations in the commercial sizes and grades of fruit on the 10 heaviest producing trees in comparison with the 10 lowest producing trees in the experimental performance-record plat of Valencia oranges. The percentages are based on the weight of the average crop per tree for a 4-year period. Figure 5 shows similar variations based on the number of fruits produced.

nection that several of the conditions which were considered essential for the location of the performance-record plats were prohibitive to the production of large crops. It is also interesting and important, especially from the standpoint of dollars and cents, to note that the highest producing trees bore 33 per cent of their crop in the most desirable and valuable sizes, while the low-yielding trees had only 18.7 per cent of their crop in these sizes. Figuring the productions here shown on the acre basis at the rate of planting in the performance-record plat, it is found that the high producing trees bore 172 packed boxes as compared with 50.4 packed boxes per acre from the lowest producing trees. The values, delivered at the packing house, of

these calculated crops figured on the basis of the actual prices obtained during the investigational period, and considering the variations in grades and sizes produced per acre by the two groups of trees, would be \$311.32 and \$84.17, respectively.

This correlation of heavy yield and superior commercial grade in the production of trees of the Valencia strain is very important from the standpoint of the stabilization of the variety through bud selection based on performance records. Figures 4, 5, and 6 indicate that the propagation from the highest yielding trees means not only heavier production, but also improvement in the grade and size of fruit.

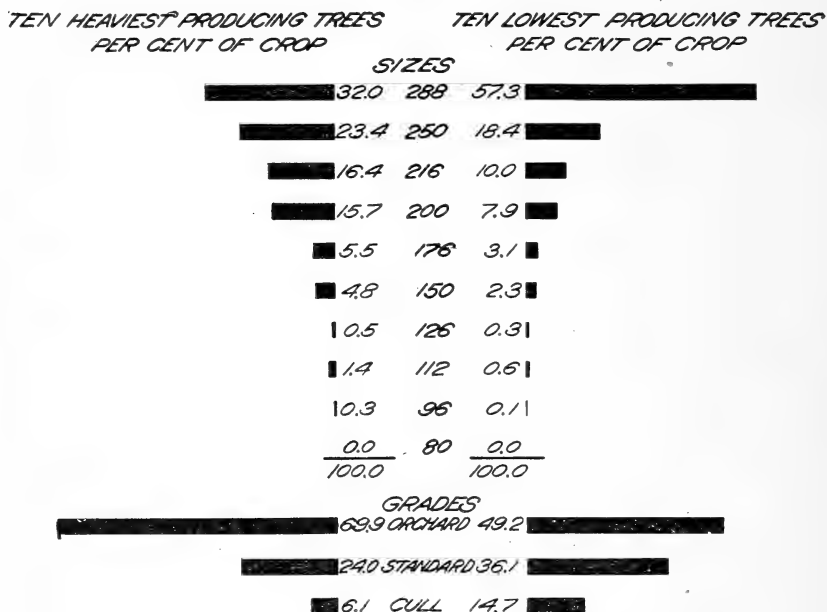


FIG. 5.—Diagram showing the variations in the commercial sizes and grades of fruit on the 10 heaviest producing trees in comparison with the 10 lowest producing ones in the investigational performance-record plat of Valencia oranges. The percentages are calculated from the number of fruits in the average crop per tree for a 4-year period. Figure 4 shows similar variations based on the weight of the crop.

Figure 7 shows graphically the relative number of variable fruits in the total crops of trees of the various strains of the Valencia orange occurring in the investigational performance-record plat. The diagram illustrates very well the comparative freedom from such fruits which characterizes the trees of the Valencia strain of this variety and the larger proportions of variable fruits which occur in the poorer and more undesirable strains. It is interesting to note that on the trees of the Barren strain, in addition to the almost entire lack of a crop of any sort, 84.3 per cent of what was produced was made up of sporting fruits. In counting the variable fruits on a tree only those showing some variation from the general type of the fruits

produced by that tree were recorded. For instance, in the case of the trees of the Valencia strain all other than Valencia fruits were considered as variable ones, while for the trees of the Corrugated strain all other than Corrugated fruits were recorded. For the trees of the Sporting strain all other than typical Valencia-strain fruits were counted as variable ones.

The comparative freedom of many trees of the Valencia strain from variable fruits indicates the possibility of controlling bud variability in propagation in commercial orchards by bud selection based on performance records.

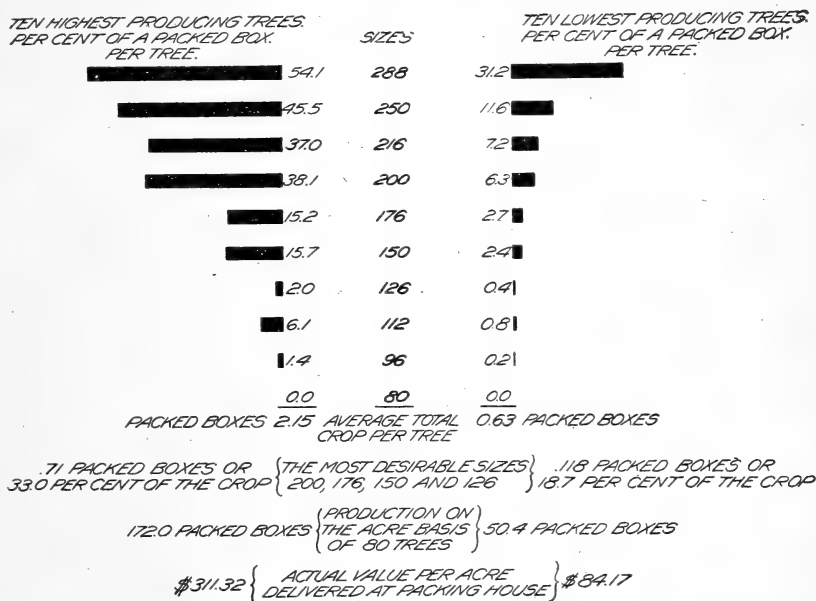


FIG. 6.—Diagram showing the average number of fruits of the various commercial sizes produced annually during the 4-year period, 1912 to 1915, inclusive, by the 10 highest yielding and the 10 lowest yielding trees in the investigational performance-record plat of Valencia oranges. This production is expressed as percentages of a packed box calculated from the average number of fruits of the different sizes. The percentage of most desirable sizes is also stated, and the production on the acre basis is shown and its value calculated from the actual returns during the four years.

The average number of seeds per fruit produced by trees of some of the various strains of the Valencia orange is shown in figure 8. This diagram, in comparison with Table IV, shows a very close correlation between the number of seeds per fruit and the comparative amount of Orchard-grade fruit produced by trees of the different strains here listed. It appears that the presence of three or four seeds per fruit is characteristic of the Valencia strain.

Many other interesting characteristics of the various strains of the Valencia orange have been studied during the progress of these investigations, but those presented here are among the most marked

and important. All the data show that it is very important to isolate the strains of this variety and, for commercial purposes, to propagate only the best of them.

COMPARATIVE VALUE OF THE STRAINS.

Any statement of the comparative value of the various strains of the Valencia orange must be understood as applying only to present conditions. What the future of some of these strains may be under different cultural and market conditions no one can now say.

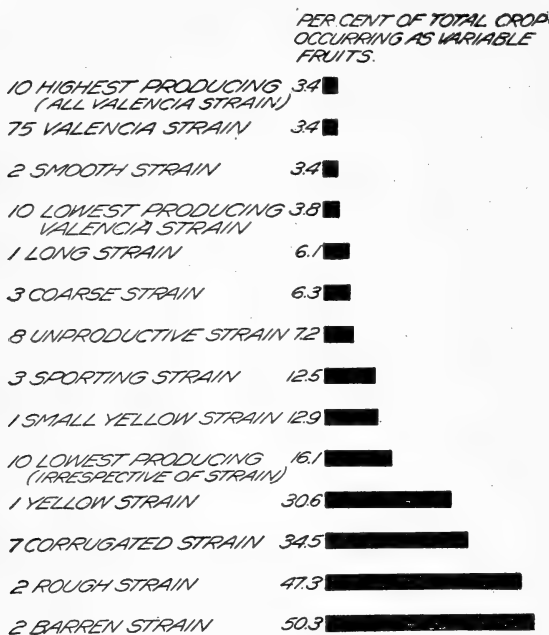


FIG. 7.—Diagram showing the relative number of variable fruits found in the average total crops of trees of different strains of the Valencia orange in the investigational performance-record plot during the 4-year period, 1912 to 1915, inclusive.

Under existing conditions, only one of the twelve strains here described is of commercial value, though three others are of possible value to orange growers. In some cases the inferior strains are not only unproductive, but the fruits produced by them are poor in quality or unattractive in appearance.

From a commercial standpoint the Valencia strain is the most valuable found so far in these investigations. Some others, especially the Smooth, Yellow, and Navel

strains or selections from them, may prove desirable additions to the present varieties of summer-ripening oranges. After the value of any new strain has been determined, considerable time is required for its introduction and trial in sections having different climatic and soil conditions. This work of necessity is of a careful, experimental nature, requiring several years to obtain reliable results.

The remaining strains described in this bulletin are undesirable in nearly every respect, as will be readily apparent from the records and descriptions of them already presented. Since commercial orange growing is conducted for the profit to be obtained thereby, the further propagation of these inferior strains or their culture in

established plantings should be discouraged. For these reasons it seems wise for the present to concentrate effort upon the stabilization of the Valencia strain by means of bud selection based on performance records and intimate knowledge of the individual tree.

THE UNINTENTIONAL PROPAGATION OF UNDESIRABLE STRAINS.

The prevailing method of securing bud wood of the Valencia variety has been to cut it either from bearing trees in established orchards, or, to a limited extent, from young nursery or nonbearing trees. Where the buds have been cut from bearing trees little or, usually, no selection of parent trees has been practiced.

Bud variations have been propagated unintentionally by nurserymen because the existence and importance of such variations have been unknown until very recently. The occurrence of individual trees in the performance-record plats bearing mainly fruit identical with the fruit variations occurring individually or as limb sports in other trees and the existence of similar limb sports in the parent trees from which the performance-record trees were propagated are evidences of

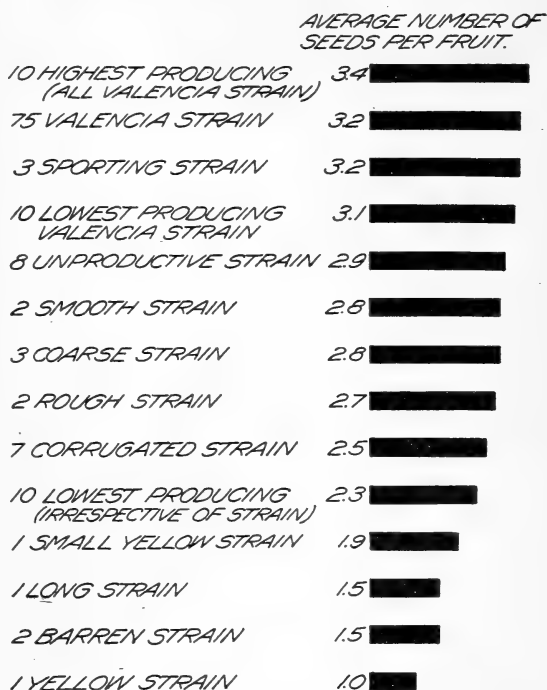


FIG. 8.—Diagram showing the average number of seeds found in fruits from the trees of the various strains of the Valencia orange in the investigational performance-record plat during the 4-year period, 1912 to 1915, inclusive. A large, a medium, and a small fruit from each of the three grades, that is, nine fruits from each tree, were cut each season and the seeds from each fruit carefully counted.

the propagation of these diverse strains from bud variations. From the fact that the most variable trees are usually the most vigorous in vegetative growth and that the most vigorous-growing, nonfruit-bearing wood has been usually selected for propagation, the proportion of trees of the variable strains in established orchards has been increasing continually in the later plantings as compared with the early propagations of this variety. Because of the lack of knowledge in the past of the existence of bud variations, no one can

be blamed for the unfortunate and undesirable propagations of poor strains which have been so generally made. However, now that bud variability in trees of this variety has been established definitely, any propagator who does not carefully select his bud wood from trees of the best strain on the basis of their performance records will not be able to excuse the poor results of his propagations on the ground of the lack of information on this subject.

THE ISOLATION OF STRAINS THROUGH BUD SELECTION.

In the beginning of these investigations fruit-bearing bud wood was selected from limb variations in trees of the Valencia and other strains and top-worked in bearing trees in order to get them into fruiting quickly. About 100 such propagations have come into bearing, and as far as can be judged from trees of their age they have in every instance reproduced the strains which were propagated.

Later, as opportunity has permitted, the bud variations have been propagated on nursery stocks. These progeny tests will require several years to secure reliable performance-record data, but in so far as such trees have fruited the results have confirmed those secured by top-working bearing trees.

Enough evidence has been secured in these investigations to warrant the assertion that all of the 12 strains described in this bulletin can be isolated through bud selection. It seems probable that other strains also can be isolated in the same manner.

This conclusion does not include the idea that bud variation within these strains can be entirely eliminated. On the contrary, the investigations have shown that variation will likely continue as long as the strains are propagated. What has been demonstrated is that variation can be controlled by bud selection to such an extent that the individuals of a strain can be brought to a condition of practical uniformity as regards crop production and other characteristics.

Bud selection should be based on definite knowledge of the individual tree, which can be secured most satisfactorily by means of performance records and careful study. A thorough investigation of most of the established Valencia orchards in the light of individual-tree records will reveal the necessity for greater care in selecting buds for use in propagation.

The bud wood found most satisfactory in these investigations is that bearing typical fruits of the strain desired and of the one or two periods of growth preceding the production of the fruits. One or more fruits of the desired strain should be cut off with each bud stick as an indication or label showing the probable character of fruit that will be produced by the buds immediately back of the fruit. Figure 9 shows a bud stick cut in this manner with typical fruits of

the Valencia strain attached. When such bud wood is used, a larger number of desirable buds can be secured from heavy bearing

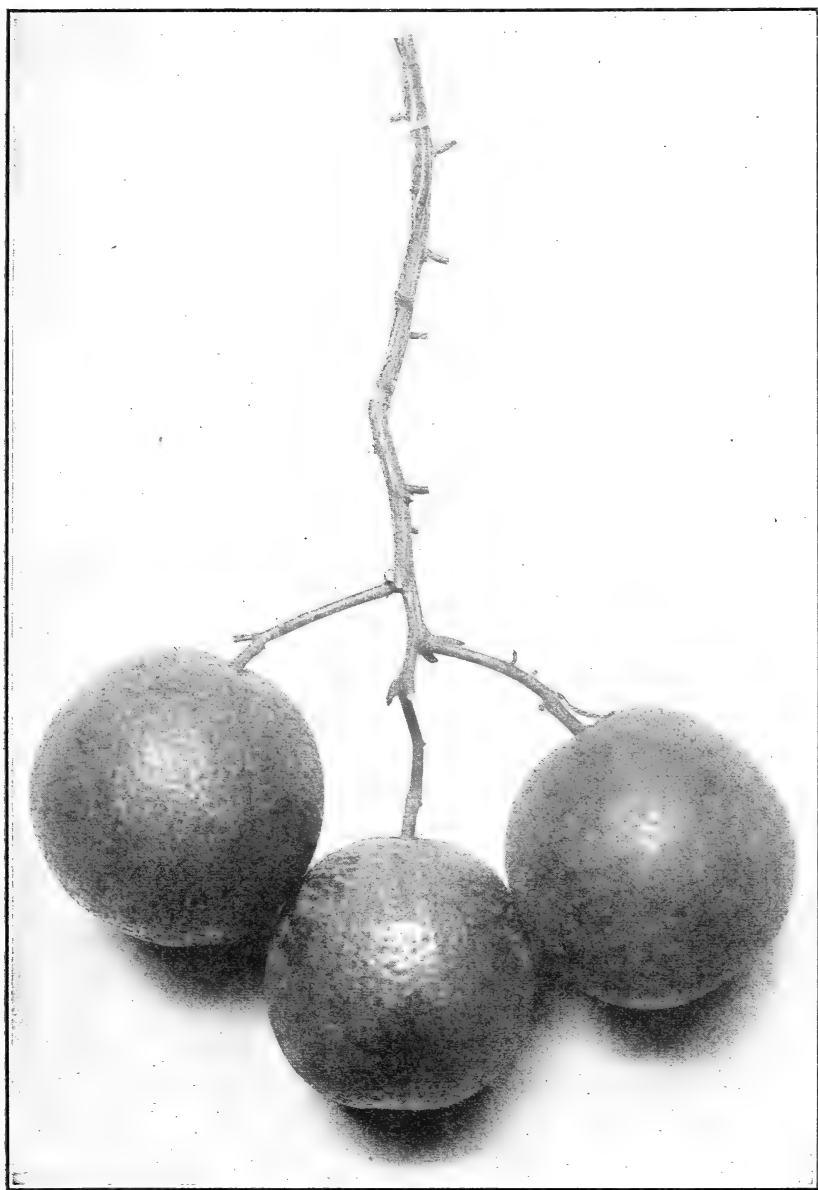


FIG. 9.—A Valencia orange bud stick of fruit-bearing wood cut with typical fruits of the Valencia strain attached. (About one-half natural size.)

trees than from less productive ones. When bud wood of this character was first recommended for use, nurserymen and propagators were almost unanimous in their objections to it on account of its

small size. Since that time this prejudice has gradually disappeared and thousands of buds from such wood have been used successfully in both experimental and commercial propagations.

If bud wood is desired at times when the fruits are unripe or when the bud wood is not in condition for use, it should be cut when the ripe fruits are available for inspection and stored in sterilized moss until needed.

The identification of a valuable strain is of vital commercial importance to the entire orange industry. The segregation of the inferior strains is of interest only from an experimental standpoint. The propagation of valuable strains will result not only in an increased production, but what is equally important, in a uniform production of crops of greater commercial value.

TOP-WORKING UNDESIRABLE TREES.

Healthy Valencia orange trees of inferior or undesirable strains can be successfully top-worked, using the kind of bud wood described in the preceding paragraphs. This bud wood can be used either as grafts or, as is the usual practice, for budding directly into some of the main limbs.

The selection of trees to be top-worked should be made before their fruits are picked. While trees of some inferior strains are easily recognized from their habits of growth or foliage characteristics, it is desirable wherever possible to base the selection of trees to be top-worked on their performance records and fruit characteristics. The selection of bud wood for top-working purposes should also be based on individual-tree performance records associated with an intimate knowledge of tree and fruit characteristics secured from careful observations in the orchards.

In top-working established trees, two or three of the main limbs should be selected for the foundation of the new heads. Two buds should be inserted in each of these limbs, from 12 to 24 inches above the fork of the trunk. After the buds have united with the older limbs, these limbs should be cut off about 6 inches above the point of insertion of the buds, and the cut surfaces covered with grafting wax or some pruning compound. The trunks and remaining portions of the limbs should be heavily whitewashed or otherwise protected, in order to prevent injuries from exposure. About a year later the stubs of the original limbs should be cut back close to the young buds, making the cuts oblique in order to facilitate their healing, and the cut surfaces should be again waxed or painted. In every case great care must be exercised in removing all sprouts from the trunk and old limbs in order to develop the new heads entirely from the inserted buds.

It is essential that the rebudded trees be inspected from time to time for the first year or two, in order that they may be cared for intelligently. The growth from the rebuds must be thinned occasionally, so that strong, open, and well-arranged tops will be secured. Insect enemies attacking the tender growth of the rebuds must be destroyed. Ten-year-old trees of inferior strains of the Valencia orange rebudded to the Valencia strain by the use of fruit-bearing bud wood usually will begin bearing in two or three years, reaching normal production in about four or five years.

As a result of these investigations, more than 5,000 undesirable Valencia orange trees in California orchards have been top-worked with buds selected from the most desirable trees in the investigational performance-record plats. The oldest tops grown from such buds are now more than four years old. So far not a single failure has been observed in transmitting the characteristics of the parent trees by means of the selected buds. Several thousand trees of undesirable strains of the Washington Navel orange and Marsh grapefruit also have been top-worked with selected buds of those varieties in the same manner during the past five years with equal success. This positive evidence as to the possibility of improving undesirable trees by top-working has resulted in the widespread adoption of this practice by California citrus growers.

SUMMARY.

In proportion to the area of the established Valencia orange orchards in California, the Valencia orange is being planted more extensively in that State than any other variety. It is now the leading summer-bearing orange variety grown in the State.

The object of these investigations is to discover methods of practice for the conservation and stabilization of the variety.

The plan of the investigation is a careful, detailed, and intimate study of the individual tree, the results of which are called individual-tree performance records.

The Valencia trees in these investigations were propagated from the variety originally introduced into California from Florida under the name of Hart (*Hart's Tardiff*).

In the performance-record plats considered in these investigations there are trees of 12 important strains and of many minor strains which have originated from bud mutations.

The frequent occurrence of bud variations in trees of this variety is of definite importance in the consideration of means for the improvement of the production of established orchards, the isolation of the best strains, and the control, as far as possible, of bud variation through bud selection based on performance records.

The most valuable strain of this variety is the Valencia. Some other strains may be of value under certain conditions.

Trees of the Valencia strain are most productive and bear the largest quantities of the best-grade fruit and the most valuable sizes for commercial purposes.

Trees of the Valencia strain produce fewer variable fruits than those of other strains.

All the strains described can be isolated through bud selection based on individual-tree performance records.

Healthy trees of undesirable strains in established orchards can be top-worked and their value improved thereby when fruit-bearing bud wood from selected trees of the Valencia strain is used for this purpose. A practical method for locating such trees and bud wood and a discussion of their treatment in commercial orchards are presented in Farmers' Bulletin 794 of the United States Department of Agriculture, "Citrus-Fruit Improvement: How to Secure and Use Tree-Performance Records."

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